Message

From: Vaughan, Molly [Vaughan.Molly@epa.gov]
Sent: 6/4/2018 11:30:32 PM
To: Douglas, Mark [douglas.mark@epa.gov]
Subject: FW: 06_06_2018_Federal_State_Meeting_Agenda.docx
Attachments: 06_06_2018_Federal_State_Meeting_Agenda.docx

-----Original Message-----
From: POA Special Projects [mailto:poaspecialprojects@usace.army.mil]
Sent: Monday, June 04, 2018 10:30 AM
To: Bob Loeffler <bobl@jadenorth.com>; Brooke Merrell <brooke_merrell@nps.gov>; Curyung Tribal <courtenay@curyungtribe.com>; 'cvaughn@achp.gov' <cvaughn@achp.gov>; Daugherty, Linda (PHMSA) <linda.daugherty@dot.gov>; David Seris (David.M.Seris@uscg.mil) <David.M.Seris@uscg.mil>; Douglass Cooper <douglass_cooper@fws.gov>; Hassell, David (PHMSA) <david.hassell@dot.gov>; John Eddins <jeddins@achp.gov>; Kevin Pendegast <kevin.pendergast@bsee.gov>; 'mary_colligan@fws.gov' <mary_colligan@fws.gov>; McCafferty, Katherine A CIV USARMY CEPOA (US) <Katherine.A.McCafferty2@usace.army.mil>; McCall, John <john.mccall@bsee.gov>; McGrath, Patricia <mcgrath.patricia@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>; Moselle, Kyle W (DNR) <kyle.moselle@alaska.gov>; Nathan Hill <manager@lakeandpen.com>; POA Special Projects <poaspecialprojects@usace.army.mil>; Pres William Evanoff <nondaltontribe@yahoo.com>; Wesley Furlong <wfurlong@narf.org>
Subject: 06_06_2018_Federal_State_Meeting_Agenda.docx

All,
I will send the Cooperating Agency Coordination plan in another email.

Message

From: Vaughan, Molly [Vaughan.Molly@epa.gov]
Sent: 7/16/2018 7:03:25 PM
To: McGrath, Patricia [mcgrath.patricia@epa.gov]; Godsey, Cindi [Godsey.Cindi@epa.gov]; Pepple, Karl [Pepple.Karl@epa.gov]; McAlpine, Jerrold [McAlpine.Jay@epa.gov]; Palomaki, Ashley [Palomaki.Ashley@epa.gov]; Wake, Neverley [wake.neverley@epa.gov]; Hough, Palmer [Hough.Palmer@epa.gov]; Schofield, Kate [Schofield.Kate@epa.gov]; Maley, Timothy [maley.timothy@epa.gov]; Eckley, Chris [Eckley.Chris@epa.gov]; Barton, Justine [Barton.Justine@epa.gov]; Douglas, Mark [douglas.mark@epa.gov]; Muche, Muluken [Muche.Muluken@epa.gov]
Subject: REVIEW REQUEST - Pebble Preliminary Ch. 4 Sections
Attachments: Sec4.18_Water&SedQual_FINAL.docx; Sec4.22_Wetlands_FINAL.docx; Sec4.26_Vegetation_FINAL.docx; Sec4.1_Intro_FINAL.docx; Sec4.5_Recreation_FINAL.docx; Sec4.11_Aesthetics_FINAL.docx; Sec4.14_Soils_FINAL.docx; Sec4.16_SurfaceWater_FINAL.docx; Sec4.17 Hydrogeology_FINAL.docx; Comment spreadsheet.docx

Hello All,
The Corps has distributed some very preliminary draft sections of Chapter 4 for Cooperating Agency review. These documents do not contain the actual project analysis, but appear to be more of a framework to work from in completing the analysis and EIS text. The sections include heading, some introductory-type text, and some blank tables. The Corps did not provide detailed instructions for review, but I recommend that we review from the perspective of determining whether the skeleton of the analysis presented here appears that it will address the key issues for review, and provide recommendations for inclusion of any issues that appear to have been overlooked in the current structure.

Here are the specific section assignments, similar to last time:

- 4.1 Intro – Molly
- 4.5 Recreation – Molly
- 4.11 Aesthetics – Molly
- 4.14 Soils – Mark/Palmer
- 4.16 Surface Water Hydrology – Tim/Mark/Palmer/Muluken
- 4.17 Hydrogeology – Tim/Mark/Palmer/Muluken
- 4.18 Water and Sediment Quality – Cindi/Tim/Chris
- 4.22 Wetlands/ Special Aquatic Sites – Mark/Palmer
- 4.26 Vegetation – Mark/Palmer

The Corps has requested a quick turnaround for review, therefore please send me any comments you may have on these sections by COB 7/24. I am hoping, given the brevity of these documents, that this timeframe will be achievable, but please let me know as soon as possible if it will not.

Please provide your comments in the attached comment table format.

It may be helpful to look back at the issues we recommended for analysis in our scoping comments - I have saved the final version of that letter on the Sharepoint Site here:

Internal Web Address / Ex. 6

Thank you,
Molly

-----Original Message-----
From: McCoy, Shane M CIV USARMY CEPOA (US) [mailto:Shane.M.Mccoy@usace.army.mil]
Sent: Thursday, July 12, 2018 3:22 PM
To: Vaughan, Molly <Vaughan.Molly@epa.gov>; McGrath, Patricia <mcgrath.patricia@epa.gov>
Subject: Draft Chapter 4 comments due 7/31/2018

For your agency review.

Vr

Shane McCoy

Page	Section	Existing text (if applicable)	Recommendation

Note to Reviewers

This section is an early stage preliminary draft, and has been prepared prior to the completion of scoping for the purpose of setting analytical direction and facilitating the project schedule for completing the EIS.

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4.0 ENVIRONMENTAL CONSEQUENCES

4.1 APPROACH TO ENVIRONMENTAL ANALYSIS

Chapter 4 describes the potential impacts on the environmental resources addressed in Chapter 3 that would occur under the No Action Alternative, the Applicant's Proposed Alternative, and other action alternatives.

4.1.1 Impact Characterization

Adverse and beneficial effects of the project were evaluated and described for each of the 25 resources. Each resource section provides context for analyzing impacts by considering them generally in relation to four dimensions:

- Magnitude, or the intensity of the impact
- Duration, or how long the impact would be expected to occur or last
- Geographic extent, or where the impact would be expected to occur
- Potential, or how likely the impact is to occur.

Not every resource considers every dimension, and the level of quantified or qualified information presented is appropriate to the context of the resource. In each of the resource subsections, the methods used for analysis are described.

Project component values, such as road lengths and pad acreage, are approximations based on best available data. Due to differences in data processing systems (e.g., Geographic Information System [GIS]) and methodologies (e.g., number rounding), the values presented in the Environmental Impact Statement (EIS) may differ slightly from values presented in other project-related documents, such as permit drawings. These differences have been reviewed, and were determined to be insignificant to the analysis, as well as to the overall permitting process.

4.1.1.1 Types of Effects Considered

The National Environmental Policy Act (NEPA) requires three types of impacts to be evaluated—direct, indirect, and cumulative—as defined below:

Direct Effects: Effects caused by the action and occurring at the same time and place (40 Code of Federal Regulations [CFR] 1508.8). Limited to the proposed action and alternatives.

Indirect Effects: Effects that are "caused by an action and are later in time or farther removed in distance but are still reasonably likely. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8). Indirect effects are caused by the project, but do not occur at the same time or place as the direct effects. Limited to the proposed action and alternatives.

Cumulative Effects: Additive or interactive effects that would result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). This includes incremental impacts of the proposed action and alternatives when added to other past, present, and reasonably foreseeable future actions. Interactive effects may be either greater or less than the sum of the individual effects; therefore, the action's contribution to the cumulative case could increase or decrease the net effects. For this analysis, reasonably foreseeable future actions (RFFAs) are existing plans, permit applications, and fiscal appropriations that are external to the proposed action, and likely (or reasonably certain) to occur in the next 30 years.

[Note: RFFAs are being developed and will be added at a later time.]

4.1.1.2 Time Periods for the Impact Assessment

Impacts on some resources may vary depending on the phase of the proposed project. Accordingly, the impact assessment was divided into three time periods:

- Construction phase
- Operations phase
- Closure or post-closure phase.

Although division of analysis into these three time periods works well for most resources, it is less relevant for some resources, such as Needs and Welfare of the People (Socioeconomics), or Recreation.

4.1.2 Issues Selected for Analysis

The U.S. Army Corps of Engineers (USACE) and cooperating agencies selected substantive impact topics for further analysis, and eliminated others from evaluation. Based on scoping comments, issues were selected for analysis, and are organized by physical, biological, or social environment.

The site of the proposed project and the nature of open-pit mining activity would lead to a complex interaction between groundwater, surface water, and a number of water-related resources. The proposed project would also lead to a complex interaction between water-related resources and fish and aquatic resources. This section provides an overview of the water-related resources, and fish and aquatic resources, and their interactions with groundwater. In this document, *water-related resources* include:

- Wetlands, streams, and other Waters of the U.S. (WOUS)
- Aquatic habitat and resources
- Groundwater and surface water quality and water supplies

- Floodplains
- Riparian communities
- Terrestrial resources.

[Note: Issues will be further developed at a later time.]

4.1.3 Financial Assurances and Bonding

This section describes the concepts of financial assurances and bonding in the mining and metals industry; the requirements for bonding under the State of Alaska; and Pebble Limited Partnership's (PLP) proposal for financial assurances.

[Note: This section will be further developed at a later time.]

4.1.4 Evaluation of Potential Failures

[Note: This section will be further developed at a later time.]

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As an initial draft, it is incomplete in many ways, and contains numerous placeholders to be addressed as more information becomes available. The Scoping Comment Period has not closed, Alternatives to the Proposed Action have not been formally identified, information needed to complete the analysis is not yet fully available and in the process of being requested from the applicant, and the approach for topics such as spills/dam failures, traditional knowledge and cumulative effects has not been settled. In addition, supporting analysis and logic for determination of potential environmental consequences have not been fully developed. This draft is intended to frame the eventual section, and in doing so, allow USACE to see the intended topics and content for the eventual completed sections. Notes are included in many sections to identify where the analysis is incomplete.

4.5 RECREATION

For the purposes of this section, the region around the project site is defined as the area from Lake Clark National Park and Preserve south to Katmai National Park and Preserve, and from the Mulchatna River east to the western Kenai Peninsula. See Figure 3.2-1 for generalized land status.

4.5.1 No Action Alternative

Under the No Action Alternative, the Pebble Project would not be developed. No construction, operation, or closure activities would occur at the Mine Site or Amakdedori Port, or in the Transportation Corridor or Natural Gas Pipeline Corridor. Therefore, no future direct or indirect effects on recreation resources would be expected. Exploration activities currently associated with the project would cease. Helicopter traffic related to these exploration activities would likely decrease. Although recreation use of the Mine Site is minimal, such a decrease in helicopter traffic would be noticeable to recreation users of the Newhalen River and the northern shoreline of Iliamna Lake near Iliamna.

4.5.2 Action Alternative 1 – Applicant's Proposed Alternative

The following sections describe anticipated recreation impacts from the project's four major components: the Mine Site, Amakdedori Port, the Transportation Corridor, and the Natural Gas Pipeline Corridor. For economic impacts related to commercial and recreational fishing, see Section 4.6, Recreational and Commercial Fisheries.

4.5.2.1 Mine Site

Recreation use at the Mine Site is minimal, consisting of some sport hunting and fishing and occasional snowmachine use. Flights taking recreationists to various destinations in the region may also pass over the Mine Site.

Construction, operation, and closure at the Mine Site may affect sport hunting and fishing on state lands surrounding the project area. Project-related activities, such as blasting and operation of heavy equipment and helicopters, would adversely affect the recreational experience for hunters and anglers by changing the setting from a quiet wilderness area to a developed industrial area within visual and auditory distance of the Mine Site. The noise generated by these activities would also displace wildlife from the immediate Mine Site area,

EPA-0135-0004522

and likely from lands immediately surrounding the project area, thus reducing the likelihood of hunting success close to project components. Therefore, hunters, anglers, or guides who currently use the immediate vicinity would likely stop using these areas and would be displaced to other areas during construction, operation, and closure activities.

Given the low estimated use of the Mine Site and immediate surrounding area for sport hunting and fishing, project-related noise and activities at the Mine Site would result in minimal displacement of sport hunting and fishing use, likely to other state lands in the area with similar habitat. However, project-related noise and aircraft traffic that would be noticeable to recreation users on the Newhalen River, Upper Talarik Creek, and the upper North and South Forks of the Koktuli River would detract from the quality of the recreation experience, potentially resulting in some displacement of activities to other areas. For further analysis, see Section 4.11, Aesthetics; Section 4.19, Noise; Section 4.23, Wildlife Values; and Section 4.24, Fish Values.

Project construction, operation, and closure at the Mine Site would also physically remove acreage available for recreation. However, given the likely low use of the site for recreation, the loss of 6,874 acres (Mine Site footprint) for recreation would likely result in minimal displacement of recreation use to other nearby state lands where similar recreation opportunities and settings exist.

Project-related noise and activities would not be likely to affect recreational settings or activities in Lake Clark National Park and Preserve, the nearest regional recreation destination and known recreation use area to the Mine Site. As stated in Section 4.11, Aesthetics, the Mine Site would/would not be visible from this park unit; and as described in Section 4.19, Noise, Mine Site construction and operational noise would not affect sensitive receptors there.

[Note: This paragraph will be updated with information about visibility of the Mine Site from recreation areas when the results of RFI 34 (viewshed analysis) are received.]

Activities at the Mine Site would be visible and potentially audible to visitors flying over the Mine Site to reach regional recreation destinations such as Lake Clark National Park and Preserve or nearby lodges, fishing the Upper Talarik Creek, and accessing the North Fork and South Fork Koktuli River for recreational river floating purposes. The presence of the mine, a large industrial use in an otherwise generally primitive area, may adversely affect the recreation experience for visitors flying over the Mine Site by causing a change in the recreation setting. Because of the Mine Site's location relative to nearby lodges and airstrips/airports, only a few flight paths cross the Mine Site; thus, visitors flying into the area would be affected by the presence of the project. The recreation experience for visitors on these flights would be adversely affected during project construction, operations, and closure.

Recreation by construction and operation staff would be expected to occur elsewhere (i.e., beyond the Mine Site), because site rules would prohibit hunting, fishing, or gathering on-site to minimize impacts on local subsistence resources. The mine would operate on a fly-in, fly-out basis. Therefore, non-resident staff members would not likely contribute to an increase in recreation use, although some may occasionally stay in the area for recreational trips to nearby destinations. As described in Section 4.3, Needs and Welfare of the People—Socioeconomics, operation of the mine is not expected to generate a large increase in the number of full-time residents.

4.5.2.2 Amakdedori Port

The Amakdedori Port site is located on state lands designated for habitat use by the Kenai Area Plan (ADNR 2001). The Kenai Area Plan does not mention recreation use, although there may be recreational boating, overflights, hunting, fishing and incidental wildlife viewing near the port site. Boat traffic to and from the port would be minimal: up to 27 concentrate vessels and 33 supply barges per year during operations. Therefore, activities at Amakdedori Port would result in minimal adverse impacts on recreational boat traffic, and thus, on boating experiences and opportunities around the port site and in Cook Inlet. The visual impacts of the port would affect the recreation setting for boaters.

The project may affect incidental wildlife viewing, hunting, and fishing opportunities at the port site, to the extent that they occur. Noise and activities would displace wildlife and fish from the area, thus adversely affecting wildlife viewing, hunting, and fishing opportunities and experiences by reducing the likelihood of seeing wildlife or catching fish.

In addition, project-related noise and activities during construction, operation, and closure at Amakdedori Port would adversely affect the recreational experiences of visitors within visual and auditory distance of the port site because of the change from a quiet, undeveloped area to a developed site with visible facilities, generators, and in-water facilities. The adverse effects would displace from this area those visitors who prefer a quiet, undisturbed recreation setting, or who participate in recreation opportunities such as wildlife viewing, hunting and fishing, which typically require a quiet, undisturbed recreation setting.

Overall, because recreational use of the Amakdedori Port site is low even during the peak summer season, project-related wildlife and fish displacement, noise, and activities would result in minimal displacement of wildlife viewing and fishing uses to other nearby shoreline areas.

The port site, including construction, operation, and closure activities, would be visible from flights over the site to regional recreation destinations such as Katmai National Park and Preserve or towns farther west such as King Salmon or Naknek. Although the recreation use of McNeil River State Game Refuge is limited by permit numbers, and the use of Augustine Island and nearby shoreline areas is low, on-water sightseeing and/or wildlife viewing may occur in these locations. Construction, operation, and closure at Amakdedori Port could adversely affect the recreation experience for visitors participating in sightseeing or wildlife viewing opportunities in these surrounding areas, by causing a change in the recreation setting to a more developed and less remote, primitive area. However, given the distance of the port site from these areas, which would reduce the port's visibility, and the likely low level of recreation use at these nearby locations, impacts on recreation experiences would be limited.

[Note: This paragraph will be updated with information about visibility of Amakdedori Port from recreation areas when the results of RFI 34 (viewshed analysis) are received.]

The project would not result in changes in access to McNeil River State Game Refuge or Sanctuary. Visitors fly into the sanctuary, where the main recreation use areas are located. McNeil Camp, the main access point to the sanctuary and refuge, is located 12 miles south of the Amakdedori Port site.

4.5.2.3 Transportation Corridor

The volume of recreation use is likely low in numbers along the north and south mine access road corridors, the Kokhanok Airport spur road, and the Iliamna spur road. However, many consider recreation use opportunities to be of extremely high quality in these areas, particularly along the Newhalen River and Upper Talarik Creek by the north access road, and in the Gibraltar River and Lake portions of the south access road corridor, which some local lodges advertise as offering guided fishing, hunting, and sightseeing trip options (Haugen et al. 2003). Recreational sport hunting or snowmachine use may occur occasionally within these road corridors. See Section 4.12 Transportation and Navigation for impacts to snowmachine use for travel. Some boating takes place at Iliamna Lake and could be affected by the ferry. Both motorized and non-motorized boating may occur, either as activities in themselves and as a means of accessing other recreation opportunities, primarily fishing. Fishing is the main recreation opportunity at Iliamna Lake.

Noise and activities along the Transportation Corridor during project construction, operation, and closure would affect the quality of sport hunting, fishing, and other recreation activities on state lands and along creeks in and surrounding the project area by generating potential noise and visual impacts. Impacts on sport hunting and fishing opportunities and experiences would be similar to those described above for the Mine Site.

Similar to the Mine Site, project-related noise and activities would not likely affect recreational settings or activities in Lake Clark National Park and Preserve. As stated in Section 4.11, Aesthetics, the Transportation Corridor would/would not be visible from this park unit; and as described in Section 4.19, Noise, Transportation Corridor construction and operational noise would not affect sensitive receptors there.

[Note: This paragraph will be updated with information about visibility of the Mine Site from recreation areas when the results of RFI 34 (viewshed analysis) are received.]

Activities in the road and ferry terminal portions of the Transportation Corridor would also physically remove acreage available for recreation during project construction, operation, and closure. However, given the likely low use of these portions of the corridor for recreation, the loss of 1,128 acres for recreation would likely result in minimal displacement of recreation use to other state lands in the general area with similar habitat.

As stated in Section 4.3, Needs and Welfare of the People—Socioeconomics, limited access to the roadways and ferry terminal would be available to local residents and businesses only, even after closure of the mine, and would be provided only in scheduled, escorted convoys. Therefore, the Transportation Corridor facilities would not induce recreation or expose previously inaccessible areas to public access and use (RFI 27).

Activities in the Transportation Corridor may be partially visible to and potentially audible for visitors flying over the corridor to reach regional recreation destinations such as Lake Clark National Park and Preserve, float trip destinations (on the Mulchatna, Gibraltar, and other rivers), or nearby lodges. The presence of roads, ferry terminals, and ferry in an otherwise generally primitive area may adversely affect the recreation experience for visitors flying over the Transportation Corridor because of the change in the recreation setting from remote and primitive to more developed and seemingly accessible. Because of the narrow road corridor and vegetation along the roadways and the size of the ferry terminals, the corridor would likely be visible to most visitors only briefly. The recreation experience for visitors on these flights could be adversely affected.

The Transportation Corridor, including construction, operation, and closure activities at the site, would/would not be intermittently visible from the northern edges of Katmai National Park and Preserve and the McNeil River State Game Refuge, depending on the elevation of the viewpoint.

[Note: This paragraph will be updated with information about visibility of the Transportation Corridor from recreation areas when the results of RFI 34 (viewshed analysis) are received.]

The project would also affect incidental wildlife viewing along the Transportation Corridor; the primary recreation use in these areas is likely from other activities, such as fishing. Movement and distribution of bears and other terrestrial mammals through the Transportation Corridor to the McNeil River State Game Refuge and Katmai National Park and Preserve would be disrupted, thus construction and operational activities in the south access corridor would have some adverse impacts on wildlife viewing in both of those recreation areas. See Section 4.23, Wildlife Values, for more information on impacts to bear movement and distribution.

Iliamna Lake provides opportunities for wildlife viewing, although there are no known opportunities specific to the proposed ferry terminal locations, ferry route, or pipeline route. Fishing is the primary recreational use of the lake, and extensive opportunities for fishing are available given the lake's size. The project would likely displace wildlife and fish from the locations of the ferry terminals and ferry route during all phases, thus reducing the likelihood of viewing any wildlife or catching fish in and immediately adjacent to the project area. Project noise would also change the recreation setting of the terminal sites from quiet and remote to developed and active. Therefore, all project phases would adversely affect wildlife viewing and fishing experiences and opportunities around the Iliamna Lake portions of the Transportation Corridor. Other locations around the lake would be available for displaced wildlife viewing and fishing use.

Project-related noise and activities during construction, operation, and closure could adversely affect boating on Iliamna Lake. Construction of the pipeline and ferry terminals and operation of the ferry would likely displace boaters from the area immediately surrounding the equipment, ferries, and facilities. Boaters would likely be displaced to other areas of the lake during construction, operation, and closure to avoid the noise and hazards presented by the equipment and activities. Project-related noise and equipment would particularly affect non-motorized boating use, a generally quieter activity that requires more time and effort to circumnavigate in-water obstructions. One ferry trip per day would occur during operations, which would not be expected to contribute considerably to boat traffic on the lake. Although recreational lake boat traffic may slow down and avoid the ferry, alternative open water would be available for boating use during ferry operations. See Section 4.12, Transportation and Navigation, for impacts to non-recreational lake traffic.

4.5.2.4 Natural Gas Pipeline Corridor

From the Amakdedori Port site to the Mine Site, the Natural Gas Pipeline Corridor is adjacent to the Transportation Corridor, and potential impacts on recreation have been described above. Existing recreation use along the pipeline alignment in Cook Inlet and on the Kenai Peninsula consists of boating on the inlet and recreation use on the peninsula. Boating on Cook Inlet is both an activity in itself and a means of accessing other recreation opportunities such as fishing, wildlife viewing, birdwatching, and beachcombing.

[Note: This paragraph will be updated when the updated GIS data for the project footprint are received.]

Equipment present on Cook Inlet during project construction and closure would be visible and audible to recreational boaters within a certain distance, and would likely temporarily displace any boating and fishing use from the area immediately surrounding the equipment and construction activity; however, alternate open water is available for use by displaced boaters or anglers. Recreation experiences for non-motorized boaters would also be temporarily adversely affected by noise and activity by equipment used during construction or closure, which would affect the recreation setting of the state recreation area for these users.

[Note: This paragraph will be updated when the updated GIS data for the project footprint are received.]

Noise and activities during project construction and closure may also temporarily adversely affect recreation experiences for other visitors to Anchor River State Recreation Area. Visitors participating in camping, picnicking, and hiking may also be adversely affected by the change in the recreation setting caused by the noise and project activities, thus adversely affecting their recreation experiences. Some visitors may be displaced from the site temporarily because of the change in recreation setting to other state parks or locally managed recreation sites along the Kenai Peninsula.

The pipeline would be located south of Augustine Island in Cook Inlet. Although no recreation occurs on the island itself, some sightseeing of the island's volcano and wildlife occurs from the water. Therefore, equipment and noise associated with construction and closure may temporarily adversely affect sightseeing opportunities and experiences along the south side of the island. However, displaced boats would be able to view the island from other locations around the island that were not affected by project equipment and noise.

The pipeline would not be visible above ground (it would be located below ground, on the seafloor, or below the seafloor in the inlet) and would not remove any acreage from use for recreation opportunities. Recreation experiences for on-water or state park unit visitors may be temporarily affected during pipeline operations because of the presence of boat traffic during pipeline maintenance.

4.5.2.5 Cumulative Effects

[Note: This section will be updated at a later time.]

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4.11 AESTHETICS

4.11.1 Methods

Potential impacts on aesthetics and visual resources were assessed by determining the overall change in landscape character and scenic integrity based on an assessment of visual contrast, scale dominance, and viewer experience as perceived from various Key Viewing Areas (KVAs).

The mechanisms by which effects on visual resources were assessed include:

- The *magnitude or intensity* of effects on visual resources was measured by the level of visual contrast created by the project. Magnitude or intensity was also informed by the scale of contrasting features relative to the existing landscape, and by the anticipated exposure of viewers to these features, including the angle from which a viewer is exposed to an effect (viewer geometry).
- The *duration* of the effects was measured by the anticipated temporal extent of effects (temporary, long-term, or permanent).
- The *extent* of the effects was measured by the extent of moderate to strong visual contrast, and was summarized as localized, extended, or regional.

The context of the effects was considered, and measured by the perceived sensitivity of viewers and the potential for the effects to alter the human experience of the landscape.

As described above, the magnitude of the impact was determined by assessing visual contrast and scale dominance in the context of the prevailing viewer experience. These metrics were assessed as follows:

- *Visual Contrast:* The Bureau of Land Management (BLM) Contrast Rating Procedure was used to determine visual contrast that could result from the construction and operation of the project (BLM 1986). The project would not directly affect federal land; however, the BLM Contrast Rating Procedure is an established and developed methodology commonly used to assess visual impacts. This method assumes that the extent to which a project results in adverse effects on visual resources is a function of the visual contrast between the project components and the existing landscape character. Levels of contrast are defined as follows:
    - *None* – The element contrast is not visible or perceived.

  - *Weak* – The element contrast can be seen but does not attract attention.
  - *Moderate* – The element contrast begins to attract attention and begins to dominate the characteristic landscape.
  - *Strong* – The element contrast demands attention, would not be overlooked, and is dominant in the landscape.
- *Scale Dominance:* The contrast created by a project is directly related to its size and scale as compared to the surroundings in which it is placed. Scale dominance refers to the scale of an object relative to the visible expanse of the landscape that forms its setting (BLM 1986). A dominant feature of a landscape tends to attract attention to it and becomes the focal point of the view. Where two or more features both attract attention and have generally equal visual influence over the landscape, they are considered co-dominant. An object or feature that is easily overlooked or absorbed by the surrounding landscape is considered subordinate. Scale dominance was classified using the following metrics:
  - Not Visually Evident (NVE)
  - Visually Subordinate (VS)
  - Visually Evident (VE)
  - Dominant (D)
- Viewer experience was assessed by considering viewer duration, viewer geometry, and distance:
  - *Viewer Duration:* Viewer duration or exposure refers to the length of time project features may be in view. This description discloses whether expected viewer exposure would be limited to a short duration and/or small number of viewpoints, or would be of a prolonged duration and/or experienced from multiple viewpoints.
  - *Viewer Geometry:* Viewer geometry refers to the spatial relationship of the observer to the viewed object (i.e., the project), including both the vertical and horizontal angles of view (USDOI 2013). The vertical angle of view refers to the observer's elevation relative to the viewed object. The horizontal angle of view refers to the compass direction of the view from the observer to the object. Visibility is typically greater for observers whose viewing angle is directed toward a project feature than for those with a lateral view.
  - *Distance:* The degree of perceived visual contrast and scale dominance of an object is influenced by the object's distance from the viewer. As viewing distance increases, the project appears smaller and less dominant. Likewise, as distance increases, the apparent contrast of color decreases (BLM 1986). Distance from project components is classified as follows:
    - Immediate foreground (less than 3 miles)
    - Foreground–middle ground (3–5 miles)
    - Background (5–15 miles)
    - Seldom seen (beyond 15 miles).

4.11.2 No Action Alternative

Under the No Action alternative, the project would not be constructed, and would not have any new effects on aesthetics.

4.11.3 Action Alternative 1 – Applicant's Proposed Alternative

4.11.3.1 Mine Site

Mine Site activities would vary in scale. Collectively, these activities would be expected to result in strong visual contrasts, given the scale of the disturbance. Geographic extent would be extended, with moderate to strong visual contrast. Direct effects from the construction and operation of the Mine Site would be of high intensity when viewed from these locations.

Viewer duration would be intermittent to prolonged, depending on the activity of the viewer. The duration of impacts would be long term, extending beyond the life of the project.

[Note: Visual contrast, other potential visual effects, viewer groups from KVAs (Table 4.11-1) will be developed based on visual simulations, and the geographic extent of impacts will be determined by viewshed models, following the receipt of RFI 34.]

Table 4.11-1: Impact Metrics for the Mine Site from Key Viewing Areas

Key Viewing Areas	Project Component	Viewer Group	Magnitude				
			Visual Contrast	Scale Dominance	Viewer Duration	Viewer Geometry	Viewer Distance

4.11.3.2 Amakdedori Port

Amakdedori Port would be located near the mouth of the McNeil River in Kamishak Bay and near Augustine Island. Development of the port would change the configuration of the shoreline and create an industrial feature in an otherwise natural landscape in Kamishak Bay and has the potential to dominate the viewer experience.

The port facilities and associated components would result in strong visual contrast against the surrounding landscape. Visual contrast would be strongest when viewed from Kamishak Bay. It would also be visible to regional residents who might access the site overland from the west, for the purposes of subsistence activities. Increased project-related boat traffic on Kamishak Bay within Cook Inlet would be visually evident from the foreground, middle ground, and background distance zones. The port would/would not be visible from the Alaska Maritime National Wildlife Refuge and the shoreline near the mouth of McNeil River at the edge of McNeil State Game Refuge. [Note: This paragraph will be edited following the receipt of the viewshed analysis from RFI 34.]

The Amakdedori Port would have high visual contrast against the existing landscape (Table 4.11-2). The vertically erect, geometric facilities would appear dominant and contrast against the low marshlands, with the backdrop of the rolling hills and mountains. Indirect effects on recreation and tourism could result if the natural character of the landscape were compromised in this localized area.

The duration of direct impacts would be long term, as an agreement with the landowner would leave the port facilities in place for use as an industrial port.

[Note: Visual contrast from KVAs (Table 4.11-2) will be developed based on visual simulations, and the geographic extent of impacts will be determined by viewshed models, following the receipt of RFI 34.]

Table 4.11-2: Impact Metrics for Amakdedori Port from Key Viewing Areas

Key Viewing Areas	Project Component	Viewer Group	Magnitude				
			Visual Contrast	Scale Dominance	Viewer Duration	Viewer Geometry	Viewer Distance

4.11.3.3 Transportation Corridor

The Transportation Corridor could be viewed by local residents, visitors, subsistence users, and mine workers. A strong line would be caused by the construction of the road system, contrasting with the native structure of the landscape. This line would be evident when intermittently viewed by air travelers, overland visitors pursuing sports fish and other recreation pursuits in the vicinity of the corridor, and regional residents who might access the site overland from the west, for the purposes of subsistence activities.

Visual contrast in the Transportation Corridor would be expected to result from the construction and operation of roads and ferry terminal infrastructure (Table 4.11-3), which would include daily truck and ferry vessel traffic. The ferry terminals would appear distinct against the shoreline of Iliamna Lake, as the form and line of the structures would contrast with the natural character of the surrounding landscape.

Visibility of new access roads would be visually limited when viewed from land-based positions, as existing vegetation and topography would block views of these features. The visual contrast of the road system would be most evident from superior viewer positions (such as higher elevations) and/or by aircraft. The geographic extent of impacts would be localized.

Viewer exposure would be intermittent to prolonged, depending on the activity of the viewer. The duration of impacts would be long term, extending beyond the life of the project.

[Note: Visual contrast from KVAs (Table 4.11-3) will be developed based on visual simulations, and the geographic extent of impacts will be determined by viewshed models, following the receipt of RFI 34.]

Table 4.11-3: Impact Metrics for the Transportation Corridor from Key Viewing Areas

Key Viewing Areas	Project Component	Viewer Group	Magnitude				
			Visual Contrast	Scale Dominance	Viewer Duration	Viewer Geometry	Viewer Distance

4.11.3.4 Natural Gas Pipeline Corridor

Because the Natural Gas Pipeline Corridor would follow the Transportation Corridor, it is not expected to be visually evident, as it would be absorbed within the impact area and viewed as a component of the Transportation Corridor.

On the Kenai Peninsula, the compressor station would create a weak visual contrast against the surrounding landscape. [Note: This paragraph will be edited following the receipt of the updated project footprint.]

[Note: Visual contrast from KVAs (Table 4.11-4) will be developed based on visual simulations, and the geographic extent of impacts will be determined by viewshed models, following the receipt of RFI 34.]

Table 4.11-4: Impact Metrics for the Natural Gas Pipeline Corridor from Key Viewing Areas

Key Viewing Areas	Project Component	Viewer Group	Magnitude				
			Visual Contrast	Scale Dominance	Viewer Duration	Viewer Geometry	Viewer Distance

4.11.3.5 Cumulative Effects

[Note: This section will be updated at a later time.]

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Note to Reviewers

This section is an early stage preliminary draft, and has been prepared prior to the completion of scoping for the purpose of setting analytical direction and facilitating the project schedule for completing the EIS.

As an initial draft, it is incomplete in many ways, and contains numerous placeholders to be addressed as more information becomes available. The Scoping Comment Period has not closed, Alternatives to the Proposed Action have not been formally identified, information needed to complete the analysis is not yet fully available and in the process of being requested from the applicant, and the approach for topics such as spills/dam failures, traditional knowledge and cumulative effects has not been settled. In addition, supporting analysis and logic for determination of potential environmental consequences have not been fully developed. This draft is intended to frame the eventual section, and in doing so, allow USACE to see the intended topics and content for the eventual completed sections. Notes are included in many sections to identify where the analysis is incomplete.

4.14 SOILS

This section describes potential impacts on soils resulting from each project component. Mitigation and control measures would incorporate structural and non-structural best management practices (BMPs) to address erosion and stormwater runoff. The evaluation also assumes that activities would be performed in accordance with prepared water management and sediment control plans, and necessary Alaska Department of Environmental Conservation (ADEC) permits and stormwater pollution prevention plans (SWPPPs). This includes typical or standard practice activities and BMPs when none are specified in project documents.

4.14.1 No Action Alternative

Under the No Action alternative, the project would not be constructed, and would not have any new effects on soils.

4.14.2 Action Alternative 1 – Applicant's Proposed Alternative

Impacts to soil resources from the Alternative 1 include those related to soil disturbance and erosion. Soil quality is also evaluated for the Mine Site due to potential fugitive dust impacts from sources of concern. Factors used to evaluate soil impacts include soil type and area of disturbance; erosion based on BMPs and foreseeable control measures using common industry practices; planned reclamation and objectives; and anticipated effects on soil quality based on planned project activities.

Evaluation of soil impacts assumes that sediment control measures, BMPs, and adaptive control strategies would be established in a water management and sediment control plan prepared prior to construction and operation; and that proposed earthwork would sufficiently meet necessary conditions required for approval of an ADEC Clean Water Act Section 402 Stormwater Construction and Operation Permit and a Stormwater Discharge Pollution Prevention Plan prior to construction. Other agencies that may require additional considerations related to upland soils include the Alaska Department of Natural Resources (ADNR) for an Approved Pipeline Right-of-Way (ROW) Permit; the Alaska Department of Transportation (ADOTPF) for a Utility Permit on ROW; Kenai Peninsula Borough (KPB); and U.S. Army Corps of Engineers (USACE) Section 404/10 Permit.

4.14.2.1 Mine Site

This section describes potential effects on soils at the Mine Site from construction through reclamation and post-closure management.

Soil Disturbance

Varying degrees of soil disturbances would occur at the Mine Site throughout construction to post-closure. Disturbances would range from the complete removal or permanent burial of pre-existing soil conditions, to reclaimed surfaces following Mine Site operations. Soils impacted at the Mine Site would include surface or very shallow soils (less than 20 inches), shallow soils (10 to 20 inches), moderately deep soils (20 to 40 inches), and deep soils (40 to 60 inches). Soils generally considered most valued and sensitive to disturbances from an ecological perspective are the productive, organic-rich materials in very shallow to moderately deep soils. None of the soils in the project footprint are considered suitable for agricultural purposes.

Principal components associated with soil map units at the Mine Site that would be disturbed (Figure 3.14-1) include:

- IA7: typically less than 20 inches of black and reddish-brown fine thixotropic volcanic ash over gravelly glacial till
- IA9: thin surface mat of partly decomposed plant litter mixed with volcanic ash, with loamy volcanic ash extending up to 30 inches above glacial till or bedrock (Exploratory Soil Survey of Alaska [ESS], Rieger et al., 1979).

The ESS while useful as a general soils map, does not provide site-specific interpretations. For this reason, deviations or variations from these soil descriptors at the Mine Site likely exist.

Soil disturbances can also impart adverse impacts to supporting vegetation and ecological communities. For this reason, salvage of organic-rich growth media and select overburden having growth media attributes is a significant component in the restoration of impacts through reclamation. Additional discussion regarding productivity losses and impacts to wetlands and vegetation are provided in Sections 4.22, Wetlands/Special Aquatic Sites, and 4.26, Vegetation. Additional discussion regarding overburden and disturbances to surficial geology is also provided in Section 4.13, Geology.

The total acreage of soil disturbance that would potentially occur at the Mine Site is approximately 6,875 acres. Most of the disturbances would occur in soils associated with soil map unit IA9 (4,960 acres), with the remaining disturbance associated with soil map unit IA7. The total acreage of soil disturbances includes major earthworks over the four-year construction period, and Mine Site operation up to closure. The total acreage estimate does not include reclamation of various Mine Site infrastructure that would partially restore or reduce soil disturbances during the closure period.

Mine Site facilities not required for post-closure activities would be reclaimed in accordance with State of Alaska requirements. Facilities that would be reclaimed include the potentially acid-generating (PAG) waste and pyritic tails storage facility; the bulk Tailings Storage Facility (TSF); overburden stockpiles; milling and processing facilities; and non-essential roads. Progressive reclamation of the seepage recovery systems, main water management pond, and treatment plants would be performed in post-closure as water recovery rates diminish (e.g., from the bulk TSF) and water quality becomes suitable for discharge to downstream drainages. With the exception of overburden stockpiles, all reclamation would occur after operations. Mine Site infrastructure that would not undergo reclamation includes the open pit (820 acres); mine water treatment plant; power generation facilities; inert monofill in the disturbed footprint; quarry sites;

and limited camp, storage facilities, and access roads. These components would result in permanent disturbances to existing soil conditions.

[Note: Acreages in above text will be revised following receipt of updated project footprint reflecting changes to Mine Site facilities, as described in PLP 2018.]

Overburden would be salvaged as growth media or re-purposed as construction material. Overburden removal would start during construction and continue through operation to support pit expansion. Segregated non-growth media overburden would be stockpiled at a dedicated location southwest of the open pit. The overburden stockpile would be contained in a prepared berm constructed of non-mineralized rock. Surface soils and overburden with growth media attributes would be stockpiled at various locations throughout the Mine Site for future reclamation use. Any waste rock used for construction purposes would be geochemically tested prior to use to avoid adverse impacts to soil and water during operation and closure.

Reclamation would include the dismantling and removal of infrastructure; in situ demolition of impermeable concrete pads and foundations; and disposal of inert materials in an on-site monofill. Disturbed areas would be graded and contoured to conform to the landscape and direct surface water runoff. Scarification or ripping of ground surfaces would promote water infiltration and reduce erosional runoff. Salvaged growth media would be applied, in addition to natural revegetation, soil amendments, or application of proposed reclamation seed mixtures.

Although soil conditions underlying the TSF footprints would result in permanent soil disturbances, each would be reclaimed to conform to designated post-mining land use, as administered by the ADNR. The pyritic tailings and PAG waste would be placed in the pit lake. The liner below the pyritic tailings and PAG waste facility would be removed, and bermed structures leveled. This would be followed by application of salvaged growth media and surface restoration. The bulk TSF would remain in place after controlled dewatering and dry closure, resulting in a permanent landform. The bulk TSF surface would be graded and contoured as needed for drainage control. Growth media would be added for seeding and revegetation, including the embankments.

The intensity of impacts to soil from ground disturbances at the Mine Site would range from noticeable compaction and stress on supporting ecological communities (e.g., vegetation), to acute or obvious changes due to complete burial or removal. Reclamation during closure would minimize soil disturbance to large portions of the site; however, irreversible changes would result from permanent infrastructure required throughout post–closure as well as the remaining pit (pit lake). Soil disturbance would extend across watersheds, but would remain within Mine Site footprint and project boundaries. The context of impacts would disturb surface soil types considered usual or ordinary resources that are widely distributed in the region.

Soil Quality

Potential soil quality impairments at the Mine Site could result from wet or dry atmospheric deposition of fugitive dust derived from orebody sources. These include ore deposit mining operations (e.g., drilling and blasting); ore transport, storage, processing, and handling (including concentrate); and wind erosion of exposed bulk tailings. The cumulative deposition of dust throughout the construction and operation periods could result in adverse changes to surface soil chemistry. Impacts could include elevating concentrations of chemical constituents (e.g., metals) found in orebody materials above those found in existing soils.

Fugitive Dust Constituents of Concern

[Note: This section will be developed following receipt of RFI 007 response regarding fugitive dust emissions. Text will summarize air quality evaluations, metals concentrations in fugitive dust sources, and dispersion modeling inputs.]

Dust Deposition on Soils

[Note: This section will be developed following receipt of RFI 009 response regarding fugitive dust deposition modelling. Text will include dispersion and deposition modeling results, and predicted distribution and accumulation rates in shallow soils at the end of mine life.]

Reasonable Maximum Exposure Concentrations

[Note: This section will be developed following receipt of RFI 009 response regarding fugitive dust deposition modelling. Text will include statistical evaluation of baseline and predicted dust concentrations for constituents of concern (e.g., selected metals).]

Dust Control

The project design incorporates a number of measures to minimize fugitive dust. Coarse ore would be stockpiled in a covered steel-frame building to minimize dust emissions. Baghouse-type dust collectors would be present at each conveyor-fed ore transfer point between the coarse ore stockpile and semi-autogenous grinding ("ball") (SAG) mills. Water would be added for dust suppression purposes at the SAG mill to alleviate additional baghouse infrastructure. Specialized bulk cargo containers equipped with removable locking lids would contain thickened concentrates for delivery to Amakdedori Port.

The pyritic tailings and PAG waste would be completely inundated with water during operations. This removes the potential for wind erosion and dust dispersion from sources with elevated metals concentrations. The tailings associated with the bulk TSF cell would have tailings beaches, which would be susceptible to wind erosion and fugitive dust emissions throughout operations. The bulk TSF cell would eventually be reclaimed through contouring of surfaces and application of growth media for revegetation and surface stabilization, eliminating the beaches as a dust source following closure activities.

Summary of Soil Quality Impacts

[Note: Text pending, awaiting RFI responses].

Erosion

Varying extents of hydraulic and wind erosion would occur throughout all phases of the project at the Mine Site. Without applied mitigation and control measures, erosion can result in adverse water quality and physical impacts to soils, waterbodies (e.g., lakes and streams), wetlands, and ecological communities. Depending on the magnitude and frequency of unmitigated erosion, sediment or particulate transport can extend well beyond the source. Planned activities at the Mine Site would incorporate structural and non-structural BMPs to address erosion and stormwater runoff (PLP 2017). The evaluation of erosion at the Mine Site assumes that all applicable activities would be performed in accordance with prepared water management and sediment control plans, and necessary ADEC permits and SWPPPs.

The greatest potential for hydraulic erosion under planned conditions at the Mine Site would likely occur during the year-round construction phase, coinciding with the longest period of soil disturbances. Removal of vegetative matting would expose fine-grained silty loam, volcanic ash mixtures in shallow surface soils (less than 30 inches deep) that are less tolerant of water and wind erosion. Deeper soils consisting of coarser-grained glacial till and colluvium mixtures would be comparatively less susceptible to erosional processes. Much of the finer-grained (i.e., shallow) soil mixtures exposed during construction would be removed due to undesirable engineering properties (e.g., loading and compaction) required for infrastructure construction, and placed in salvaged growth media stockpiles.

Insignificant wind and hydraulic erosion is anticipated when soils are frozen during winter months. Consistent frozen soil conditions generally range from four to five months between the fall and spring shoulder seasons (HCG 2011). The greatest potential for erosion would most likely be during rainfall events that typically occur during the fall months. Such events have been documented to result in erosional losses on the Kenai Peninsula and Pile Bay-Williamsport Road . Precipitation and runoff associated with spring breakup and snowmelt would also provide a mechanism for hydraulic erosion.

Wind-induced erosion would be comparatively less than hydraulically driven processes in the construction phase, due to seasonal meteorological conditions and cohesive forces associated with soil moisture. Soil susceptibility to wind erosion is influenced by moisture and particle size. A soil matrix composed of larger grains is less capable of retaining moisture, but less susceptible to wind transport. Although finer-grained soils are generally less tolerant to wind erosion, they are more capable of retaining cohesive moisture. Moisture is anticipated to minimize wind erosion of finer-grained surface soils for most of the year; however, the potential would be greatest during drier periods lasting 1 to 2 months during the summer. Wind erosion could be mitigated through dust control watering as needed during summer construction months.

Vegetation clearing, grubbing, and overburden excavation using heavy equipment (e.g., loaders excavators, dozers, dumptrucks, graders) would occur during the construction phase. Initial construction would include establishing temporary facilities that would be incorporated into the operational footprint. This would be followed by construction of long-term infrastructure such as the TSFs, mill sites, water/sediment ponds and treatment facilities, power generation, access roads, pit, and other long-term or permanent infrastructure. Destabilization of interim soil surfaces would be vulnerable to erosion if not stabilized or covered by infrastructure. Interim soil stabilization and erosion control measures would be necessary during construction to prevent or mitigate erosional issues. Furthermore, construction would not start without an ADEC-approved discharge permit and coverage under an SWPPP (PLP 2017).

Select Mine Site infrastructure that would have inherent design characteristics to minimize or control erosion during construction and operations is discussed below.

Waste Rock and Overburden

Waste rock would be used to construct large portions of Mine Site infrastructure, including TSF embankments, water management pond (WMP) embankments, and roads. The geochemical composition of all non-PAG construction waste rock would be determined in advance to segregate PAG sources. Initial materials used to construct TSF embankments would also be sourced from two quarries at the Mine Site. The coarse-grained rock used to construct the TSF and other Mine Site infrastructure is considered to have a low susceptibility to hydraulic and wind erosion.

Excavated overburden would be stockpiled at a designated location southwest of the open pit, and contained in a non-mineralized rock berm impoundment for stabilization. Suitable overburden would also be used for construction as needed. Fine- and coarse-grained soils salvaged for future growth media would also be stockpiled at various locations throughout the Mine Site. Stockpile surfaces would be stabilized to minimize erosion potential. Typical stabilization measures may include engineered contouring of slope angles and drainages;

rolling and compaction of exposed surfaces; interim seeding and revegetation; silt fencing; and impoundments or sedimentation ponds.

Water Management

All runoff water that comes in contact with Mine Site facilities or is derived from the open pit would be captured. This would also include any entrained sediment in runoff from erosion. A Water Management Plan is currently under development that would include water treatment options and strategic discharges of treated water. A sediment control plan during construction would also address runoff and associated sediment control measures, BMPs, and adaptive control strategies. Collected water would be treated prior to discharge if it could not be diverted.

[Note: This section will be revised following receipt of Water Management Plan in response to RFI 019.]

Water management structures (e.g., berms, channels, collection ditches) would be designed to accommodate a 100-year, 24-hour rainfall event. Sediment control ponds would be designed to treat a 10-year, 24-hour rain event, and safely accommodate a 200-year, 24-hour rainfall event.

Runoff upgradient of the TSFs during construction would be intercepted by a cofferdam and released at a discharge point downgradient of all construction activities in the same watershed. Runoff from the TSF embankments during construction would also be captured. Similarly, runoff from larger excavations associated with the construction of long-term infrastructure (e.g., process plant, camps, power plant, storage areas) would be routed to settling ponds prior to discharge.

Comparatively less soil erosion from water would occur during operations due to a diminished need for soil removal. Completed construction of most long-term infrastructure would coincide with established water management and sediment control plan measures. Although water and sediment control during the operations phase would emphasize contact water minimization and management, runoff and sediment control measures would continue to be managed through BMPs and adaptive control strategies per the SWPPP. With the exception of overburden stockpiles, no mine site infrastructure would be progressively reclaimed during operations.

A greater potential for wind erosion is anticipated during operations, when the bulk TSF is susceptible to this process. Bulk tailings would be pumped and discharged through spigots along the interior of the perimeter cell, with the slurry preferentially discharged to maintain a tailings beach between the TSF embankment and supernatant pond. Although this approach minimizes potential risks associated with seepage effects on embankment stability, the fine tailings (e.g., beaches) would be susceptible to wind erosion when dried. Additional information regarding fugitive dust derived from the bulk TSF is presented in the Soil Quality discussion for the Mine Site.

The Mine Site would be reclaimed per an ADNR-approved reclamation plan that establishes requirements for designated post-mining land use. The reclamation plan would supplement or describe measures to control and mitigate erosion at the Mine Site through the post-operations period. Erosion during closure would be less than during construction, but likely greater than during operations. Large areas of destabilized soil surfaces from demolition activities and application of growth media would likely result in erosion until surface stabilization is achieved. At a minimum, similar measures established in the sediment control plan during construction would address runoff through sediment controls and BMPs. Additional measures may include future developments in available technologies or practices, and refined adaptive control strategies acquired throughout operations. Removal and reclamation of long-term water management infrastructure would progressively coincide with surface stabilization objectives.

The potential for erosion during reclamation from destabilized surfaces would likely continue for several years beyond closure. Prescribed design standards for reclaimed infrastructure and monitoring requirements would be established in the reclamation plan. Continued monitoring would be required to implement any erosional control maintenance or adaptive control measures. Prescribed monitoring would likely occur on an annual basis until surface conditions are stabilized to meet land use objectives. Indefinite monitoring would be incorporated into permanent infrastructure maintenance requirements (e.g., at the pit WTP) as needed. Although reclaimed infrastructure would be designed to withstand anomalous storm events (e.g., 100-year, 24-hour rain event), monitoring would be necessary immediately after any occurrence.

Applied erosion control and water management practices at the Mine Site during all project phases would likely maintain the intensity of impacts to within planned project design and approved monitoring and maintenance program requirements. The duration of impacts would last from completion of the activity (e.g., infrastructure construction) to months or years afterwards until stabilization criteria are met (e.g., closure revegetation). At a minimum, pre-activity levels of soil stabilization would be anticipated within 100 years after project completion. The extent of impacts would likely remain within Mine Site footprint and project boundaries.

4.14.2.2 Amakdedori Port

This section describes potential effects on shore-based, upland soils at the Amakdedori Port during construction through closure. Offshore sediment impacts resulting from intertidal and open-water construction, operations, and closure of marine facilities are discussed in Section 4.18, Water Quality.

Soil Disturbance

No current development exists at the Amakdedori Port site. Shore-based soil disturbances would mostly be attributed to construction of the terminal. The total acreage of soil disturbances at Amakdedori Port is 26 acres. Acreages of currently known soil disturbance associated with various port facilities include:

- Amakdedori Port Terminal – 23.4 acres
- Shore-based range markers – 0.7 acres
- Temporary port airstrip – 1.6 acres.

Acreages associated with soil disturbance during road construction at the port are included under Transportation Corridor. Temporary port infrastructure includes an airstrip and temporary camp. The location of the camp would coincide with other footprints retained throughout operation. [Note: Above acreages to be revised following receipt of revised footprint.]

The terminal would be constructed on engineered fill overlying nearshore beach and marine terrace deposits that extend eastward to the gravel beach high tide line. Fill would likely be derived from either road material sites or imported sources (RFI 005). The amount of dredging required for the current concept of a high-tide-only dock (PLP 2018), characterization of potential dredge material, and the location of potential dredge material disposal or reuse is under development. Although the use of lightering vessels eliminates the need for deep-water channel maintenance dredging and a large onshore dredge material stockpile, it is likely that some quantity of dredge spoils would be generated throughout the life of the port on an as-needed-basis. [Note: Above text to be revised following receipt of updated footprint, RFI 033 response, and results of summer 2018 field studies.]

Most soil disturbances at the port would result in direct impacts during the construction period, including the complete removal of soil cover at the airstrip and terminal, and placement of engineered fill over pre-existing subsurface soil conditions at the terminal. Because no additional construction would be required during operations, any subsequent disturbances to soil would likely be limited. With the exception of necessary infrastructure to support shallow draft tug and barge access to the dock, onshore port facilities would be removed during closure. No additional soil disturbances are anticipated during closure, and restoration of post-disturbance soil conditions would occur through reclamation activities (e.g., scarification, growth media, contouring, seeding).

Soil impacts at the port would largely depend on whether plans for dredging (currently under development) would use onshore disposal, and whether such materials would be removed during closure. Impact intensity could range from the noticeable burial of existing soils, to potential acute or obvious changes associated with any stockpiled marine sediment in an upland environment. The intensity and duration of effects may be reduced pending the similarity of any dredge spoils to pre-existing soil conditions. The duration of impacts could range from long-term (lasting until reclamation targets are met in closure) to extending beyond the life of the project, pending the volume and nature of potential stockpiled dredge materials. The extent of soil disturbances would be limited to the footprint of the port site. [Note: Above conclusions to be revised following receipt of updated footprint, RFI 033 response, Summer 2018 field studies.]

Erosion

Water- and wind-induced erosion would occur at the port site throughout construction, and to a limited extent during operation and closure. The potential for soil erosion would be greatest during the initial construction phase. The most invasive period of initial disturbance to pre-existing soil conditions would occur during ice-free (e.g., Cook Inlet) construction months when ground surfaces are more susceptible to erosive processes. Construction activities that would result in erosion include:

- Clearing and removal of surface cover during development of the camp, terminal, and airport
- Excavation, handling, and storage of additional overburden considered unsuitable for port design criteria
- Placement of engineered fill, and potential stockpile of dredge materials and associated drainage infrastructure.

[Note: Above text to be revised following receipt of revised footprint and RFI 033 response.]

Although limited information is available regarding specific soil characteristics at the port, the absence of ponded water and appreciable wetlands beneath the footprint is indicative of well-drained soils. Nearshore beach environment substrates reportedly consist of gravel and sand. These materials are commonly associated with soil types that have lower potentials for erosion by water and wind. The nearly level topography at the port also reduces the potential for surface runoff, scouring, and sediment transport.

Earthwork during construction would incorporate erosion control measures specified in an approved SWPPP. Typical measures may include silt fences, hay bales, temporary sedimentation basins; and repurposed brush for berms and watering for dust suppression. BMPs may include crowning or in-sloping of running surfaces; and temporary drainage channels, berms, and catchment basins.

Hydraulic erosion during operations would be comparatively less than during construction due to little additional soil removal and established SWPPP design features (e.g., culverts, swales).

Hydraulic erosion of any dredge materials that may be stockpiled could be mitigated through proper impoundment and drainage design. The potential for wind erosion could be greater during operations than construction in the event that onshore dredge disposal is planned. Variables that could influence the susceptibility to stockpile wind erosion, if planned, include the physical attributes of dredge materials (particle size distribution and cohesion); interim surface stabilization measures; constructed dimensions; and frequency and magnitude of coastal and seasonal winds. Physical conditions that are considered less susceptible to wind erosion include high moisture contents or frozen conditions, larger particle sizes, presence of surface cover, and lower slope angles to reduce wind shear. Mitigation measures that may reduce the potential for wind erosion include wind breaks, snow fencing, reduced slope angles, or watering during increased periods of susceptibility. [Note: Above text to be revised following receipt of revised footprint, RFI 033 response, and summer 2018 field study results indicating characteristics of any dredge material proposed for onshore disposal.]

Erosion during closure would be less than during construction, but likely greater than during operation. Exposed ground surfaces below removed infrastructure not required for post-closure would be susceptible to wind and water erosion for an interim period until reclamation and restoration activities are completed. The potential for erosion would be mitigated using measures similar to those described during construction. Removed infrastructure would be reclaimed in accordance with State of Alaska requirements. Gravel pads and areas of engineered fill would be contoured to conform to the natural landscape, and would promote natural runoff drainage. Ripping and scarification would be conducted to promote surface water infiltration and reduce surface water runoff and subsequent erosion. Reclamation may also include application of salvaged growth media, wetland or upland seed mixtures (e.g., broadcast), or soil amendments (e.g., fertilizers).

If onshore dredge disposal is considered, final closure of the stockpile would include drainage and surface stabilization. Typical measures that could facilitate stockpile surface stabilization include slope and top cover engineering, tracking (rolling), and seeding. [Note: Above text to be revised following receipt of revised footprint and RFI 033 response.]

Although the potential for erosion impacts at the port exists, the design of planned infrastructure and availability of successful mitigation and reclamation measures would minimize erosion. Impacts are expected to be of low intensity, assuming structural BMPs and erosion control measures, restoration at closure, and limited monitoring and maintenance through post-closure occur. The duration of effects may extend several years into the post-closure period. The extent of effects would be limited to the immediate vicinity of individual infrastructure footprints.

4.14.2.3 Transportation Corridor

This section describes potential effects on soils along the Transportation Corridor, from initial construction through closure and post-closure. Impacts associated with the natural gas pipeline and fiber optic cable run are also included in this section, because both are buried in road-prism engineered fill from Amakdedori Port to the Mine Site.

Soil Disturbance

Soil disturbance acreages associated with the proposed Transportation Corridor infrastructure (including co-located portion of the pipeline) include the following:

- South Access Road – 401 acres
- Kokhanok Airport Spur Road – 15 acres
- Mine Access Road – 345 acres

- Iliamna Spur Road – 93 acres
- North Ferry Terminal – 4 acres
- South Ferry Terminal – 23 acres
- Material sites – 247 acres total.

Access Roads

Where practicable, access road routes have been selected to minimize disturbances to wetlands and waterbody crossings, and optimize existing geotechnical and soil conditions. The top driving surface of the main access road would be 30 feet wide. The base of the roadbed prism requiring excavation and/or placement of engineered fill over soils would typically be 60 feet wide, using fill embankment construction for most segments. Along some segments of the South Access Road, the roadbed prism and slope cuts would extend approximately 75 feet wide to accommodate cut-and-fill construction methods through rough terrain. The pipeline and fiber optic cable would be buried 20 feet from the road centerline in the shoulder of the road prism.

Disturbances resulting from access road construction would include direct burial of soils, or complete removal for fill placement or cross-slope contouring. Disturbances are considered permanent, because the access roads would be required to support post-closure activities. Soil types that would be impacted along project access roads are shown on Figure 3.14-1.

Ferry Terminals

Shore-based infrastructure at the South Ferry Terminal includes a 6-acre terminal facility with a container stockyard, and an 18-acre ferry construction and laydown area. The significantly smaller shore-based infrastructure at the 4-acre North Ferry Terminal is predominantly associated with a container stockyard. Most soil disturbances at the terminals would occur during construction, which would require either direct burial of surface soils, or complete removal to accommodate placement of engineered fill materials. Where possible, overburden consisting of organic-rich materials or suitable mineral soils would be salvaged as growth medium for future reclamation at closure. No additional planned disturbances are anticipated during operations.

Both ferry facilities would be removed at closure. Restoration of post-disturbance soil conditions would occur through reclamation activities. Depending on the nature of the engineered surface or foundation, this would include removal or in-place demolition. Restoration would include grading and surface contouring; scarification or ripping to promote surface water infiltration and vegetation growth; application of salvaged growth media; and seeding with proposed mixtures as needed.

Material Sites

Fill material for Transportation Corridor construction would be acquired from 18 different material sites, including 8 along the South Access Road, 7 along the Mine Access Road, and 3 along the Iliamna Spur Road. Either overburden aggregate or blasted shot-rock fill would be sourced from the material sites. Aggregate (e.g., gravel) would be sourced from eight of the material sites, shot-rock from six of the material sites, and both from four of the material sites (RFI 035). Disturbances would include the complete removal and segregation of surface soils and overburden materials considered unsuitable for construction purposes. These materials would be salvaged for future reclamation as a growth medium. Portions of sites no longer used for material extraction would be progressively reclaimed. This would mostly occur after the construction phase, once the bulk demand for materials has been met with infrastructure completion (e.g., roads). Material sites and access roads would continue to be used throughout operations for maintenance of project infrastructure, as needed. Comparatively less soil disturbance would occur than during construction, but it would include excavation or blasting of materials on an as-needed basis. A need for materials would also persist throughout the post-closure period for continued road maintenance and other limited post-closure needs. For these reasons, incremental reclamation of disturbance impacts at materials sites would be required. Typical reclamation at gravel material sites would likely include grading and contouring of sidewall slopes; scarification or ripping to promote surface water infiltration and vegetation growth; application of salvaged growth media; and seeding with proposed mixtures as needed. No sidewall reclamation would be conducted at shot-rock material sites with 20-foot bench heights on exposed rock walls.

In summary, the intensity of impacts to soils from ground disturbances along the Transportation Corridor would result in obvious changes in soil resources from permanent fill placement, road cuts, or material site needs throughout post-closure. However, the intensity would be minimized by complete or incremental reclamation at non-permanent infrastructure (e.g., ferry terminals, portions of material sites). The duration of soil disturbances for the access roads (and to a limited extent, material sites) would be permanent and irreversible, due to continued road use for post-closure monitoring and maintenance needs. Although the extent of impacts would span multiple watersheds, impacts would be limited to areas in the footprints of individual infrastructure components (i.e., road prism, material sites).

Erosion

Similar to all other project components, stormwater and erosion mitigation and control measures would incorporate structural and non-structural BMPs (PLP 2017).

Wind Erosion

Wind-induced erosion would be comparatively less than hydraulically driven processes throughout all phases of the project along the Transportation Corridor, due to seasonal meteorological conditions, physical attributes associated with soil types present, infrastructure configuration and construction methods, and planned mitigation. Soils capable of retaining moisture in the project area are generally considered to have a low susceptibility to wind erosion due inherent moisture content from periodic precipitation or snowmelt throughout the year. For this reason, the potential for wind erosion would be greatest during drier periods lasting one to two months during the summer. If necessary, wind erosion can be mitigated through dust control watering as needed during summer months.

Similar to the Mine Site, insignificant wind and hydraulic erosion is also anticipated when soils are frozen during winter months. Furthermore, the susceptibility of completed or reclaimed surfaces during project operations and closure from wind erosion is considered insignificant. This is based on the coarse-grained characteristics of engineered fill materials used to construct Transportation Corridor infrastructure.

Where present, soils considered most susceptible to wind erosion along the Transportation Corridor include finer-grained silt and loess mixtures that are generally overlain by organic surface cover of varying thicknesses. These conditions, which are most prevalent along the South Access Road, include fine-grained, loamy, volcanic ash components associated with soil map unit IA17 (Table 4.14.-1).

Dust from truck traffic and wind erosion of road bed aggregate is considered to have a low potential for changing chemical concentrations in soils along the access roads. Material sites along the roads are well outside the Pebble Deposit, and surface soil conditions associated with the Transportation Corridor are chemically consistent with those described for the Mine Site study area (SLR Alaska Inc. et al. 2011a). Field review has not identified PAG rock at any of the road material sites. If PAG were to be identified at a site evaluation prior to use, the material site would be moved (RFI 035). Therefore, the material sources are not expected to introduce chemical impairments to soil. Transportation of concentrates from the Mine Site would be in sealed containers with locking lids, and therefore are not expected to be a source of fugitive dust along the roads.

Hydraulic Erosion

The potential for hydraulic erosion exists throughout the entire project lifecycle along the Transportation Corridor. This is evident based on erosion assessments conducted on the Pile Bay-Williamsport Road, approximately 30 miles northeast of the South Access Road (USACE 2007; KPB 2014). Although topographic variability and cross-slope conditions associated with the South Access Road are less than those traversed by the Pile Bay-Williamsport Road, periods of heavy precipitation have resulted in significant hydraulic erosion losses. Precipitation events resulting in the greatest erosional losses from surface runoff and flooding generally occur from late September through November. Specific conditions that resulted in impassable erosion washout at multiple points along the Pile Bay-Williamsport Road in the fall of 2003 included culvert and bridge crossings, and surface water drainages aligned adjacent (e.g., swale or ditch) to the road (USACE 2007).

Gently sloping or level transportation infrastructure would be less susceptible to erosional processes. These would include the ferry terminal sites and access roads constructed over glacial fluvial and moraine soil types (Table 4.14-1). Physical conditions more susceptible to hydraulic erosion along the Transportation Corridor include poorly drained, fine-grained loess or colluvium on sloped topography, waterbody crossings, road prism drainages (e.g., swales), higher-gradient slopes, and sidehill cuts. Approximate access road lengths traversing moderate and rough terrain requiring rock cuts are detailed in Table 4.14-1.

Table 3.14-1: Approximate Lengths of Access Road Terrain and Soil Types

Road Segment	Gentle Terrain	Moderate Terrain	Rough Terrain	Approximate Percent Soil Map Unit
South Access Road	3.9 miles (10%)	9.8 miles (26%)	23.6 miles (63%)	20% (IA7[2]), 80% (IA17[3])
Mine Access Road	26.7 miles (92%)	2.3 miles (8%)	None (0%)	59% (IA7), 37% (IA9[4]), 4% (HY4)
Iliamna Spur Road	2.9 miles (41%)	4.1 miles (59%)	None (0%)	47% (IA7), 53% (IA9)
Percent Total Access Roads Terrain Type[1]	46%	22%	32%	

Notes:

1. Kokhanok Airport Spur Road is not included in the evaluation due to the comparatively short road length and similar conditions to other project access roads.
2. IA7: Typic Cryandepts – Very gravelly, nearly level to rolling association.
3. IA17: Dystric Lithic Crandepts – Loamy, hilly to steep association.
4. IA9: Typic Cryandepts – Very gravelly, hilly to steep association.

Source: Rieger et al. (1979); PLP (2017)

Transportation Corridor construction and year-round construction season would result in soil disturbances considered most susceptible to hydraulic erosion. Initial construction would start in

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the spring, with development of beach heads at Amakdedori Port, followed by ferry terminal locations at Iliamna Lake. The South Access Road would continue inland from Amakdedori Port to the eastern bank of the Gibraltar River through year one. Simultaneous construction of other road segments would also include preliminary Mine Access Road completion by Year One. Contiguous road access from Amakdedori Port to the South Ferry Terminal would be established after completion of the Gibraltar River Bridge during year two of construction. Concurrent development of materials sites would occur along each road segment as accessed.

Construction phase activities that would potentially create or contribute to erosion include:

- Removal and clearing of vegetation during pre-development access road alignments, material sites, and terminal facilities;
- Overburden clearing and vegetative mat removal for cut and/or fill placement of engineered materials (e.g., aggregate, substrates);
- Overburden management that would include stockpiles or windrows of organic-rich materials and vegetation, or excavated substrates considered unsuitable for infrastructure construction; and
- Development of material sites and material site access roads.

The intensity of erosion during construction would vary along project road segments depending on soil types and physical conditions present, seasonal conditions, and construction requirements. Potential erosion may be localized at susceptible locations, such as waterbody drainages and crossings (e.g., culverts, bridges, and swales), wetlands, or intermittent sloped topography. Broader areas considered more susceptible to runoff and erosion would include continuous segments of road through rough terrain; and to a lesser extent, moderate terrain. These conditions would require steeper roadbed grades and sidehill cuts that could result in greater erosion potential from runoff (e.g., energy) and slope failure. Terrain and substrates along the South Access Road correspond with conditions that are considered most susceptible to erosion along the corridor. About 63 percent of the South Access Road would be predominantly constructed over rough, variable terrain (Table 4.14-1), where fine-grained soil types reportedly overlie shallow bedrock. Although conditions along the South Access Road appear most vulnerable to hydraulic erosion processes, the evaluation is based on generalized soil descriptions provided in the ESS, and do not account for local variations in soil conditions, or bedrock outcroppings where no soil horizon may exist.

No rough terrain requiring rock cuts is present along the Iliamna Spur Road or the Mine Access Road; however, each traverses approximately 59 percent and 8 percent of moderate terrain, respectively. The Mine Access Road would be least susceptible to hydraulic erosion, based on terrain types traversed and soil conditions. Construction methods along the Mine Access Road would require less backslope cuts (i.e., layback), foreslope contouring, and variation in roadbed grade, compared to other access roads. Furthermore, surficial glacial deposits and gravel fractions in existing soils along the Mine Access Road and Iliamna Spur Road would be less susceptible to hydraulic erosion, compared to the South Access Road.

Similar to access roads, the potential for hydraulic erosion at material sites would also vary based on source material competency (e.g., shot bedrock or aggregate) and conditions unique to each borrow site location. Construction of material sites and Transportation Corridor infrastructure would use structural and non-structural BMPs, and employ erosion control measures adequate to satisfy appropriate ADEC discharge permit requirements and coverage under an SWPPP (PLP 2017).

Ground disturbances would be progressively restored throughout construction until stabilization and restoration are achieved. Most disturbances would likely be stabilized during construction, or several years thereafter, at locations considered less susceptible. Common industry practices used to mitigate and control erosion under a variety of scenarios applicable to the Transportation Corridor access roads and infrastructure include those described in above, and the following:

- Staging of overburden materials in unused material sites or designated areas engineered to control and mitigate surface water runoff
- Spoils placement on upslope surfaces relative to resources of concern (e.g., waterbodies), with adequate setback distances.

The least amount of erosion would likely occur during operations, when stabilization of disturbed surfaces would be achieved through natural recovery, applied restoration measures, and long-term or permanent stabilization measures. Material sites and access roads would be progressively reclaimed. Typical reclamation BMPs at material sites include benching or sloping of sidewalls to suitable grades, based on material types (e.g., aggregate or bedrock); distribution of salvaged overburden growth media on pit floors and slopes; and tracking and seeding.

Continuous feedback from truck traffic during operations and/or prescribed follow-up inspections would identify areas of acute or persistent erosion. Areas of concern would be identified, and additional or more robust measures applied to meet local site-specific conditions. This would most likely be required along rough terrain associated with the South Access Road, and/or areas requiring permanent drainage controls (e.g., culverts, bridges, swales).

Erosion during closure and post-closure would likely be greater than during operations. Some erosion may be derived from the removal and reclamation of long-term facilities (e.g., ferry terminals) before complete restoration and surface stabilization objectives are met; however, most would likely be associated with permanent roads to the Mine Site. Monitoring frequencies in post-closure would typically be less than during operations, and there would be reduced access to equipment and resources. Required permanent Transportation Corridor access would result in an indefinite potential for erosion monitoring and maintenance.

In summary, varying degrees of erosion would be associated with most Transportation Corridor infrastructure during construction, operations, and post-closure. Erosion impact intensity for most transportation components would be reduced or mitigated through typical control measures, BMPs, and restoration activities, assuming that conditions required through discharge permits and prescribed SWPPP activities are met. However, soil conditions and rough terrain along the South Access Road may require enhanced design and mitigation measures. Without such measures, erosion during extreme fall storm events could result in impassable road conditions from washout on an episodic basis. Erosional susceptibilities potentially exist along other access road features, as well (e.g., culverts, swales, bridges). The duration of erosion would vary from completion of the activity (e.g., construction or reclamation), to an indefinite period in post-closure along permanent access roads. The extent of erosion effects would be mostly limited to the immediate vicinity of individual infrastructure footprints and watershed occurrence.

4.14.2.4 Natural Gas Pipeline Corridor

This section describes potential effects on shore-based upland soils from pipeline infrastructure on the eastern side of Cook Inlet north of Anchor Point. Pipeline impacts for segments of the pipeline coincident with the Transportation Corridor are addressed above. Pipeline activities resulting in disturbances to wetlands and submerged ocean and lake sediment are detailed in Sections 4.22, Wetlands, and 4.18, Water Quality, respectively.

Soil Disturbance

The cumulative total acreage of shore-based soil disturbances from pipeline infrastructure on the eastern side of Cook Inlet is approximately 5.1 acres. This would include the compressor station, laydown area, access road, metering pad, and horizontal directional drilling (HDD) work area.

HDD activities would occur during the second year of construction, followed by completion of the Anchor Point compressor station facility during year three. Construction would include clearing of vegetation and unsuitable substrates for access road installation, drilling pad preparation, and compressor facility installation. Most soil restoration measures would be conducted during and immediately after construction; however, follow-up measures may be required on a limited basis, pending winter construction activities.

Surface disturbances not associated with long-term infrastructure are expected to recover immediately after or within the first few years following construction. Soil disturbances during operations would be significantly less than during construction, because no other disturbances are planned or anticipated.

If the compressor facility is retained, and usage re-appropriated to other stakeholders after Mine Site closure, the 5.1 acres of soil disturbance would be indefinite. However, if there is no future need for the pipeline infrastructure, soil disturbances would be minimized through facility demolition and subsequent reclamation. Reclamation may include in-place abandonment of subsurface pipe; grading and contouring of ground surfaces; ripping and scarification to promote water infiltration and reduce surface water runoff and subsequent erosion; and application of seed mixtures (e.g., broadcast) or soil amendments (e.g., fertilizers).

The intensity and extent of soil disturbance effects would be greatest during construction, but would be limited to a 5.1-acre area. The duration of disturbance would be indefinite if the infrastructure is re-appropriated to another entity (stakeholder). Disturbances are expected to return to pre-activity levels within several years after closure if reclamation is performed.

Erosion

Similar to other project components, mitigation and control measures would incorporate structural and non-structural BMPs to address erosion and stormwater runoff (PLP 2017).

The topography associated with the pipeline infrastructure on the eastern side of Cook Inlet is gently sloping or nearly level. Silty loam soils associated with these conditions are considered to have a low hazard of erosion by water, and severe hazard of erosion by wind, assuming the top cover is removed. Use of HDD would provide a sufficiently wide setback distance between the project footprint and Cook Inlet bluff (about 200 feet), so that project activities are not expected to contribute to ongoing natural erosion in this area (Section 3.15, Geohazards).

Construction activities and sources that could contribute to erosion include vegetation clearing and brush removal; rutting or tearing of surface cover from equipment; excavation and trenching; and overburden management (i.e., spoils and snow). Given the limited acreage associated with infrastructure on the eastern side of Cook Inlet and available erosion control measures described above, effective hydraulic and wind erosion management is anticipated during the construction process until stabilization is achieved shortly thereafter. Little to no erosion is anticipated during operations, because no other disturbances are planned or anticipated. Similarly, stabilization of ground surfaces is expected to occur within several years after closure if reclamation is performed. Less erosion would be expected following Mine Site closure if the infrastructure is retained, and re-appropriated to another operator or entity.

In summary, the intensity of soil erosion from the limited acreage of pipeline infrastructure on the eastern side of Cook Inlet would be minimized through BMPs and erosion control measures. Surfaces would stabilize to pre-activity levels shortly after construction, and extents would be limited to areas within or bordering the disturbance footprint, and would not appreciably contribute to other naturally occurring erosional processes.

4.14.2.5 Cumulative Effects

[Note: This section will be updated at a later time.]

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Note to Reviewers

This section is an early stage preliminary draft, and has been prepared prior to the completion of scoping for the purpose of setting analytical direction and facilitating the project schedule for completing the EIS.

As an initial draft, it is incomplete in many ways, and contains numerous placeholders to be addressed as more information becomes available. The Scoping Comment Period has not closed, Alternatives to the Proposed Action have not been formally identified, information needed to complete the analysis is not yet fully available and in the process of being requested from the applicant, and the approach for topics such as spills/dam failures, traditional knowledge and cumulative effects has not been settled. In addition, supporting analysis and logic for determination of potential environmental consequences have not been fully developed. This draft is intended to frame the eventual section, and in doing so, allow USACE to see the intended topics and content for the eventual completed sections. Notes are included in many sections to identify where the analysis is incomplete.

4.16 SURFACE WATER HYDROLOGY

This section describes the potential impacts of the project on surface water hydrology. Planned mitigation related to surface water hydrology (including a water management plan) is considered part of the project description, and would be based on Pebble Limited Partnership (PLP) plan documents and engineering reports, as well as the impact analysis.

Planned mitigation may not be specified but is considered typical or standard engineering practice. In cases where planned mitigation is unknown, unclear, or an uncommon situation is encountered, mitigation recommendations are provided. Water quality is addressed in Section 4.18, Water and Sediment Quality.

[Note: Impacts on surface water hydrology will be analyzed in detail and results presented following receipt of response to RFI 019, including a water management plan, and receipt of the revised project footprint, as described in PLP (2018).]

4.16.1 No Action Alternative

Under the No Action alternative, the project would not be constructed, and would not have any new effects on surface water hydrology.

4.16.2 Alternative 1 – Applicant's Proposed Alternative

[Note: This section has been prepared in advance of response to RFI 019, Water Balance, Groundwater Model, Streamflow Reduction, Water Management Plan and the updated project footprint, as described in PLP (2018). The text will be revised following receipt of this information.]

4.16.2.1 Mine Site

The quantity and distribution of surface water in the upper tributaries of the North Fork Koktuli River (NFK) and South Fork Koktuli River (SFK) and Upper Talarik Creek watersheds would be disrupted during all or parts of the project phases. The water management plan would address strategies for surface water management during all phases of the project. Changes to surface water drainage in affected watersheds would result from construction of access roads and related drainage structures, camp and airstrip facilities, and mine tailing, waste rock storage, and water storage impoundments; and from excavation of the mine pit and associated dewatering activities.

The main objective of water management at the Mine Site would be to manage surface water originating in the project area, and to maintain the process water supply during operations. A primary design requirement would include water treatment processes for all contact water to meet water quality criteria before discharge to the environment (RFI 020). Water balance models would be developed for each phase of the project to estimate fresh water requirements, pond storage volumes, water treatment requirements, and surface water flow rates. A description of baseline water balance input parameters and calibration is presented in Section 3.16 in Chapter 3. Expected water management plans and procedures during all project phases are described in detail in Chapter 2, Alternatives, and summarized below.

Water Management Plan – Construction Phase

Water management during construction would include the following activities:

- Water diversion, collection, and treatment systems would be installed around the Mine Site for managing runoff during construction
- Water management and sediment control best management practices (BMPs), including temporary settling basins and silt fencing, would be installed during initial construction at the Mine Site
- Water management structures would be constructed. Structures would include diversion and runoff collection ditches for minimizing contact with disturbed surfaces, and sediment control measures such as settling ponds to prevent sediment from reaching downstream waters. Energy dissipation structures would be included where necessary to reduce erosion at the outlets of diversion channels and collection ditches
- The design criterion for diversion channels, berms, and collection ditches would be the 100-year, 24-hour rainfall event
- Sediment control ponds would be sized to treat a 10-year, 24-hour rainfall event and safely manage a 200-year, 24-hour rainfall event
- An open pit dewatering system would be installed and operational to provide sufficient time to draw down the water table
- Before completion of the tailings storage facility (TSF) embankments and water management structures, all water not meeting water quality standards would be treated before release. This includes water from construction pit dewatering, water that accumulates in the open pit during construction mining, runoff captured during construction of the TSF embankments, and runoff captured during construction of Mine Site infrastructure
- Temporary, modular water treatment plants (WTPs) would be used to treat contact water before construction and operations phase WTPs.

Water Management Plan – Operations Phase

The primary goal of water management and sediment control during operations would be to minimize contact water. Runoff and associated sediment control measures would be managed with appropriate BMPs and adaptive control strategies, and where water could not be diverted before becoming contact water, it would be collected and used as process water, or treated and discharged. Water management during production would include the following activities:

- Water collected from pit dewatering wells and the open pit would be pumped to the open pit water management pond (WMP) (see section 3.16, Surface Water Hydrology, for details). Water from the open pit WMP would be pumped to the open pit WTP for treatment and discharged
- Runoff from the Mine Site would be collected in the main WMP north of the pyritic TSF/potentially acid generating (PAG) storage facility and would be either used as process water or treated in the main WTP and discharged [Note: Text to be revised following receipt of updated project footprint, as described in PLP (2018).]
- Water surplus is anticipated during production under average and above-average precipitation scenarios. The water available for discharge would be less than the pre-mine flows within the mine footprint because of water lost in tailings voids, evaporation, and other minor uses. The average annual water surplus during the maximum Mine Site footprint is estimated to be 39 cubic feet per second (cfs), which would be treated and discharged throughout the year [Note: Text to be revised to address new project footprint, as described in PLP (2018).]
- Adaptive water management strategies would include the ability to provide additional water storage capacity in the bulk TSF, provide surplus storage capacity in the WMPs, and provide for expansion of the WTP rate by building excess capacity
- Additional water storage capacity would be made available under above-average precipitation conditions by directing excess water to the open pit, allowing it to flood until pumping and treatment systems restore the water stored in the system to the design level
- A comprehensive water management system would be implemented to monitor water quantity and quality. All discharge water would be monitored for compliance with state and federal permit requirements. Water released from WTPs would be strategically discharged to optimize downstream fish and aquatic habitat. Discharge locations are described in Section 3.16, Surface Water Hydrology. [Note: Text will be revised as needed following receipt of updated project footprint, as described in PLP (2018), Technical Note on Updates to PLP's Proposed Project.]

Water Management Plan – Closure and Post-Closure Phase

Water management during closure and post-closure would address both reclamation activities and long-term post-closure. The water management plan would include the following activities:

- Pit dewatering would cease once mining stops, and the water level in the open pit would begin to rise
- Surface runoff from reclaimed areas would be collected and either treated in a WTP or directed to the open pit until the runoff is determined to be suitable for direct discharge
- Free water would be pumped from the bulk TSF surface, which would eventually be graded and revegetated to direct surface runoff toward the closure spillway.
- Seepage water from embankment seepage collection systems would be collected and either treated in a WTP or directed to the pit lake until the water is determined to be suitable for direct discharge
- Water level in the mine pit would rise during closure and post-closure, forming the pit lake. Once the pit lake reaches an elevation of about 890 feet above mean sea level, water would be pumped from the pit (to maintain the water level) for treatment and discharged

- The pit lake's water level would be maintained at a level at least 50 feet below the elevation at which groundwater would flow out of the open pit, to prevent unplanned discharge and allow sufficient time to address issues that might occur with the WTP during post-closure.

North Fork Koktuli River

The majority of the mine facilities would be within the NFK watershed. The bulk TSF would be within an upper NFK tributary watershed (called Tributary 1.190). Quarries A, B, and C would also be within NFK Tributary 1.190, and the final combined size of the TSF and quarries would encompass the majority of NFK Tributary 1.190. The bulk TSF capacity would be sufficient to store tailings generated for a 20-year mine life. Construction of the bulk TSF would include three embankments: the main embankment, south embankment, and east embankment. Initial TSF design components include the following:

- Starter embankments for the main and south embankments would be constructed as part of initial TSF construction, and construction of the east embankment would begin in year 10 of operations
- A temporary cofferdam would be constructed upstream of the main TSF embankment for managing water during initial construction. The cofferdam would capture undisturbed runoff from the upstream catchment that would be pumped downstream of all construction areas and released
- Each stage of embankment design would include a freeboard allowance above the maximum operating TSF pond level and tailings beach. Freeboard allowance includes containment of the inflow design flood (IDF) and wave action
- The IDF for the TSF is the Probable Maximum Flood, which is based on the 72-hour Probable Maximum Precipitation event plus the snow water equivalent for the 1-in-10-year snowpack. [Note: Text will be revised as appropriate following receipt of response to RFIs: RFI 028, TSF IDF and Freeboard. Partial response notes that the IDF volume and freeboard above the beach will be addressed in the Water Management Plan, to be provided in response to RFI 019, Water Balance, Groundwater Model, and Streamflow Reduction.]
- The design of the TSF main embankment includes a permeable flow-through facility that would minimize water buildup in the TSF and seepage pressure on the embankment, and would provide controlled flow away from the other embankments. [Note: Text to be revised as needed after receipt of response to RFI 019, Water Balance, Groundwater Model, and Streamflow Reduction.]
- The water level would be controlled below the freeboard allowance by transferring (pumping) excess water from the TSF supernatant pond to either the seepage control pond or the main WMP
- Underdrains would be constructed beneath the entire TSF to convey seepage flow to collection and recycling systems below each embankment, and to help minimize water buildup behind the main embankment
- The pyritic TSF/PAG storage facility would be a fully lined water retention facility. The water level would be controlled by pumping excess water to the bulk tailings cell or seepage control pond [Note: Text to be revised as needed after receipt of response to RFI 019, Water Balance, Groundwater Model, and Streamflow Reduction.]
- Precipitation and runoff into the bulk TSF would collect in a small operating pond. Pyritic tailings would remain fully submerged and excess water would be pumped to

the bulk tailings cell. [Note: Text will be revised following receipt of response to RFI 019.]

Seepage and Sediment Ponds

Five seepage and sediment pond embankments would be located downstream of the TSF embankments and WMPs.

The seepage recycling pond embankments below the TSF would incorporate low-permeability core zones and grout curtains to control seepage and enhance embankment stability.

[RFI placeholder: The Preliminary Data Gaps Analysis included requests for design of seepage pond and sediment pond embankments related to water management during construction and operations.]

Water Management Ponds

The main WMP would be north of the pyritic TSF/PAG storage facility and the open pit WMP would be south of the open pit. [Note: Location description to be refined or confirmed following receipt of new project footprint as described by PLP (2018).] A sediment pond would be located downstream of each of the WMPs, and an emergency dump pond would be located downstream of the main WMP. Each of these facilities requires an embankment or berm with design considerations similar to those described for the TSF.

WMP berms and sediment pond embankments would be constructed using rock and earthen fill. Sediment control ponds would be designed to safely manage the 200-year, 24-hour rainfall event. [Note: Text to be revised following receipt of response to RFI 019, Water Balance, Groundwater Model, and Streamflow Reduction, as pertains to seepage and sediment ponds during construction and operation.]

Pyritic Tailings Storage Facility/Potentially Acid Generating Storage Facility

[Note: Text to be revised following receipt of response to RFI 019, Water Balance, Groundwater Model, and Streamflow Reduction.]

This temporary, fully lined stockpile would be located in an unnamed tributary east of Tributary 1.190. The south end of the pyritic TSF/PAG storage facility would be located along the watershed divide between the stockpile tributary and a tributary that drains south toward the SFK. A 100-foot berm would be constructed on the north side of the saddle to contain the pile and maintain drainage flow away from this saddle and the SFK watershed. [Note: Statements will be confirmed or modified after receipt of new project footprint as described by PLP (2018).]

4.16.2.2 Amakdedori Port

Runoff, Erosion, and Sedimentation

The port building would be constructed on an engineered fill patio, designed to be at an elevation high enough to avoid tidal surge from major storms. Port infrastructure would be built above the 100-year floodplain of Amakdedori Creek, although the floodplain is not well defined in current literature.

Port construction would likely cause a temporary increase in overland runoff, erosion, and sedimentation from the removal of vegetation, excavation/grading, and other ground-disturbing activities. The impact analysis includes consideration of erosion and sediment control BMPs. Low-intensity impacts could extend within the local watershed during the construction phase.

Surface Water Use

Amakdedori Creek is a meandering stream that flows into Kamishak Bay just south of the port site, and is fed by snowmelt, rainfall, and groundwater (Glass 1999). No detailed hydrologic data or stream gauge data are available for Amakdedori Creek. The estimated average flow is some 400 cfs in summer and 35 cfs in winter. The water extraction site is near the mouth, where the creek is wide and shallow, with a stream depth of 0.5 to three feet and a width of about 400 feet (Recon 2018; RFI 022).

Limited data are available regarding estimated streamflow at Amakdedori Creek. A detailed analysis of the impact on streamflow or the streambed caused by the annual extraction of 5 million gallons from Amakdedori Creek is not practical, because the streamflow reduction may not be measurable and the impact would likely be of low intensity and temporary. [Note: This section will be updated if additional hydrologic information is developed.] Alaska Department of Fish and Game (ADF&G) permitting requirements regulate the minimum streamflow required in anadromous streams. Before water extraction, PLP would be required to demonstrate that proposed water extraction volumes and rates are within permissible limits. This is especially important for water extraction during winter months, when streams experience low-flow conditions.

Marine Water in the Port Vicinity

A 2,000-foot-long earthen causeway would extend from the shore to a jetty located in 15 ft natural water depth. One side of the jetty would include a roll-on/roll-off barge access berth.

During placement of fill material for causeway construction, increased concentrations of suspended sediment would occur in Kamishak Bay for the duration of construction, and would persist for days to weeks after completion. The duration of increased suspended sediment concentrations would depend on the amount of fine sediment in the fill material. Suspended sediment would be transported within Kamishak Bay under the influence of tidal and wind-driven currents before settling on the seabed. The duration and geographic extent of suspended sediment plumes can be estimated when the grain size distribution of fill material is made available. Assuming the causeway is constructed to include with a 40-foot-wide roadbed with side slopes of 1H:5V (horizontal:vertical) and freeboard of 10 feet, the causeway footprint on the floor of Kamishak Bay would be approximately 730,000 square feet or 17 acres.

The capability of a causeway to alter oceanographic processes is well-known and understood (e.g., Colonell et al. 1992). However, the capability of a causeway to alter the density structure of the water column is more subtle. Causeway-induced influences on the water column can be important. In some cases, water column density may become stratified, which would appear as vertical or horizontal gradients in temperature and/or salinity (such as when fresher water overlies denser saltier water). In Kamishak Bay, only small sources of fresh water enter salt water; therefore, it is very unlikely that the project causeway would cause notable variations in water density. In addition, it is very unlikely that the causeway would affect overall circulation in Kamishak Bay, given its relatively short length.

The causeway would support servicing of the lightering vessels that would transport ore concentrate to the Handysize ships moored offshore. Although ship wakes and propeller wash can contribute substantially to shoreline erosion in relatively quiescent waters, neither is expected to be an issue in Kamishak Bay. Wave forecasts for wind conditions typical of Kamishak Bay (Section 3.16) suggest that the bay already has a dynamic wave climate to which the shoreline has achieved a stable equilibrium; the bay is not likely susceptible to incrementally increased wave activity as a result of the lightering vessels' wakes. Whether the seabed at or near the causeway would be susceptible (i.e., erodible) to propeller wash would depend on the composition of the seabed materials (e.g., sand, silt, rock), and on the management of lightering vessel operations. Establishment of suitable BMPs for vessel operations should be sufficient to minimize adverse impacts; namely, BMPs should include specifications for managing ferry speed (minimizing wakes) and engine power settings (minimizing bottom erosive stress) during approach and departure from the causeway berths.

During winter, sea ice could become an operational issue. The causeway may provide shelter from ice on its leeward side, but this is likely to be variable throughout the winter because of shifts in prevailing winds.

Removal of the causeway at the end of the project would cause substantial increases in suspended sediment in Kamishak Bay that would persist for days to weeks after decommissioning is completed.

4.16.2.3 Iliamna Lake

Ferry Terminals

Ferry terminals would be built on the north and south shores of Iliamna Lake. Project description noted that planned construction of causeways consisted of rock and aggregate. Some shoreline and lakebed disturbance would be expected to occur on both sides of the lake, resulting in temporary increases in suspended sediment concentrations during construction and decommissioning. Such disturbances would be limited to the immediate vicinities of the ferry terminals. Transport of suspended sediment concentrations by wind-driven currents along shore is not expected to be of long duration or to cover a large geographic area.

Vessel Operations

Both ferry terminals would support barge/tug traffic during construction, mine development, operations, and closure for transfer of equipment, materials, and supplies. Ore concentrate would be transported across the lake via an ice-breaking ferry from the north terminal to the south terminal, for transfer to overland transport to Amakdedori Port. Vessel wakes and propeller wash can contribute to shoreline erosion in relatively quiescent waters, but neither wake nor propeller wash is expected to affect the shoreline of Iliamna Lake. Wave forecasts for wind conditions typical of Iliamna Lake (Section 3.16) suggest that the lake already has a dynamic wave climate to which the shoreline has achieved a stable equilibrium; the lake is not likely susceptible to incrementally increased wave activity caused by the ferry's wake. Whether the lake bottom at or near the ferry terminals would be susceptible (i.e., erodible) to propeller wash would depend on the lake bottom materials (e.g., silt, sand, gravel, rock), and on the management of ferry operations. Establishment of suitable BMPs for ferry operations should be sufficient to avoid or minimize adverse impacts; namely, BMPs should include specifications for management of ferry speed (minimizing wakes) and engine power settings (minimizing bottom erosive stress) during approach and departure from the terminals.

Offshore Anchoring and Concentrate Transfer

Ore concentrate in containers would be loaded onto lightering vessels (barges) at Amakdedori Port and transported to deeper water where a Handysize bulk carrier would be anchored. The ore concentrate containers would be emptied directly into the hold of the bulk carrier, using a crane mounted on the lightering vessel. Primary and alternate locations are proposed for offshore concentrate transfers:

- *Primary Transfer Location* – Approximately 12 miles due east of the proposed Amakdedori Port. Based on National Oceanic and Atmospheric Administration

Chart 16440, the seabed is relatively flat and featureless with water depths of 12–14 fathoms (72–84 feet re: mean lower low water [MLLW])

- *Alternate Transfer Location* – Approximately 18 miles east-northeast of the proposed Amakdedori Port, 1–2 miles southwest of Augustine Island, between the island and the mainland. This lightering point would be used for concentrate transfer when required by sea conditions. Water depth is about 5 fathoms (30 feet re: MLLW)

Vessel Operations

Two or three lightering barges supported by tugboats would be used to move ore concentrate in containers from Amakdedori Port to the bulk carrier. Depending on which lightering point is used (i.e., 12 or 18 miles each way), about 10 trips by the lightering barges would be required to load the anchored bulk carrier over a period of 4–5 days. Transfer and unloading of concentrate would be curtailed when sea and weather conditions preclude operations.

Up to 27 Handysize shiploads would be needed to transport the expected annual concentrate production. Although some damage to seabed flora and fauna could result from each ship anchoring, a BMP could be developed to avoid excessive damage by directing ship masters not to anchor in the same location(s) each time. Sea ice in west Kamishak Bay (the alternate transfer location) could become problematic for lightering via barge/tug from early December to late March, and also for the bulk carriers at both lightering locations from mid-January to mid-March, as ice accumulates around Augustine Island (Table 3.16-9; Mulherin et al. 2001). This suggests that some ice-breaking capability between Amakdedori Port and Augustine Island could be required from December through March. Such ice-breaking capacity would be provided, including two ice-breaking tugs to support marine facility operations (PLP 2017).

4.16.2.4 Transportation Corridor

The evaluation of impacts on surface water and substrate incorporates an understanding of their probability of occurrence, and of planned mitigation in the form of engineering design and maintenance that can meaningfully reduce impacts.

Road Stream Crossings

Roads could potentially block or restrict drainage, and drainage crossings must be designed and constructed to ensure adequate streamflow. PLP's stormwater pollution prevention plan would include standard BMPs to reduce erosion and sedimentation during bridge and culvert construction. Culverts requiring fish passage would be designed based on criteria used by the Alaska Department of Transportation & Public Facilities (ADOTPF). [Note: Text will be developed to address potential impacts on drainage in the Transportation Corridor as more information becomes available. RFI 036 addresses waterbody substrate and turbidity.]

Bridge Crossings

A total of seven bridges would be constructed for the proposed project: a bridge across Upper Talarik Creek on the mine access road, a bridge across the Newhalen River on the Iliamna spur road, and five bridges along the south access road. Bridge engineering and design would vary with stream size and hydrologic properties. Instream channel work, including installation of bridge footings and embankments, would occur year-round during the first two years of construction. Table 4.16-1 lists all bridge crossings along the Transportation Corridor and relevant hydrologic data.

[Note: Table 4.16-1 to be completed as hydrologic data are available.]

Table 4.16-1: Bridge Crossings along the Transportation Corridor (North to South)

Waterbody	Stream Width at Crossing	Stream Depth at Crossing	Mean Annual Stream Discharge (cfs)
Upper Talarik Creek			
Newhalen River			
Gibraltar River			
South Creek 4			
South Creek 3			
South Creek 2			
South Creek 1			

Culverts

A total of 222 culverts would be installed at drainages along the Transportation Corridor. Culverts would be used to allow proper discharge at stream crossings, to reduce erosion, and for some crossings, would be used for fish passage. Culvert design would vary by stream size and whether or not fish passage is required. Seventy-three culvert crossings would be designed to allow for fish passage; 149 would not require allowance for fish passage. Most of the culverts would be 4- or 8-foot-diameter circular passage, with the four largest culverts 12 feet tall by 20 feet wide (not circular). The length of the culverts would vary from 77 to 256 feet (PLP 2017; PLP Application Attachment B, Culvert Schedule). Culvert sizes and types would be determined to address anticipated flow, and designs would be refined during final engineering and design.

During construction of bridges and culverts, the potential exists for increased runoff, erosion, and sedimentation as a result of vegetation removal and excavation of soil, rock, and sediment. Low-intensity consequences could extend within the local watershed during the construction phase.

Surface Water Extraction

ADF&G Fish Habitat Permit requirements regulate the minimum streamflow required in anadromous streams. Before the extraction of water from anadromous streams along the road and pipeline corridors, sufficient streamflow would need to be demonstrated to permit summer/winter extraction.

Water would be extracted from 21 designated sites along the Transportation Corridor (Figure 4.16-1). Water extraction sites may be used at any time of the year, although during the winter months, low-flow conditions may limit water availability.

Figure 4.16-1: Water Extraction Sites along Transportation Corridor

[Figure to be added later.]

The maximum projected surface water use along the Transportation Corridor during construction would be a total of 50 million gallons: 19 million gallons along the mine access road, seven million gallons along the Iliamna spur road, and 24 million gallons along the south access road. Table 4.16-2 provides estimates of streamflow and pond volumes for the water extraction sites. A total of 16 million gallons would be extracted from two sites on Iliamna Lake and five million gallons would be extracted from the large drainage of the Newhalen River. The remaining 39 million gallons would be extracted from smaller ponds and streams. Estimated average extraction rates would range from 500 to 1,000 gallons per minute, depending on the streamflow/volume of the waterbody (Recon 2018; RFI 022). All surface water extraction would require compliance with approved state permits, stipulations, and reporting requirements.

[Note: Table 4.16-2 to be completed as hydrologic data are available.]

Table 4.16-2: Hydrologic Data from Water Extraction Sites along Transportation Corridor (South to North)

Extraction of 16 million gallons from Iliamna Lake and five million gallons from the Newhalen River would likely have no measurable consequences, given the high volumes of these waterbodies. With only limited hydrologic data estimates available on other water bodies across the Transportation Corridor, determining the consequences of water extraction is not practicable at this time. Extraction of 39 million gallons from streams and ponds along the Transportation Corridor could cause streamflow or pond volumes to be reduced in some waterbodies during construction activities. Depending on streamflow/pond volume and the extraction rate, the streamflow/pond volume reduction may not be measurable, and would likely be of low intensity.

[Note: This section will be updated with more detailed hydrologic data, if available.]

Erosion and Scour at Stream Crossings

The Transportation Corridor would cross 229 waterbodies with culverts and bridges. If not properly designed, constructed, and maintained, culverts and bridge abutments may cause constricted natural streamflow, increasing water velocity at the downstream end of the structure. This could lead to localized bank erosion and scour, or erosion around the infrastructure. Erosion and scour could modify stream morphology by deepening and widening the stream channel downstream, modifying aquatic habitat, and causing sedimentation downstream. If the infrastructure would not allow for adequate flow, water could pool up on the upstream side, leading to erosion of the roadbed. In extreme cases, improper bridge or culvert design or improper construction materials could lead to collapse of the infrastructure. Culverts and bridges may also need to be designed to allow for safe fish passage. See Section 3.24, Fish Values, for information on fish and aquatic resource impacts.

The potential for erosion and scour at stream crossings is dependent on streamflow and streambed substrate and would be mitigated through engineering design and maintenance. Freshwater fish field studies scheduled for summer 2018 will include identification of streambed substrate in fish-bearing streams along the corridor (RFI 036). [Note: Text will be updated and expanded following receipt of response to RFI 036.] Culvert and bridge design will be further evaluated during final engineering and design.

4.16.2.5 Natural Gas Pipeline Corridor

Pipeline segments on land include the lengths of the mine access road and south access road. The pipeline would lie on the lake floor across Iliamna Lake, and across the seafloor of Cook Inlet. At the pipeline river crossings along the main road corridor, the pipeline and a fiber optic cable would be suspended below precast concrete decking attached to bridge infrastructure.

The 12-inch-diameter pipeline would be buried 20 feet from the road centerline, or a minimum of five feet beyond the road shoulder. Buried pipeline segments would be placed in a trench extending to a depth of 52 inches. Installation of the natural gas pipeline would involve year-round construction over a period of two years, during the second and third years of project construction.

Surface Water Extraction

Surface water extraction during pipeline construction would likely have consequences to watersheds intersected by the pipeline corridor.

Erosion and Scour at Stream Crossings

Impacts would be similar to those described for the Transportation Corridor.

4.16.2.6 Cumulative Effects

[Note: This section will be updated at a later time.]

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4.17 HYDROGEOLOGY

4.17.1 No Action Alternative

Under the No Action Alternative, the project would not be undertaken; there would be no Mine Site, Transportation Corridor, Amakdedori Port development, or Natural Gas Pipeline Corridor. Consequently, groundwater at the Mine Site would return to its pre-existing condition following cessation of exploration, monitoring, and testing activities that have been conducted in support of permitting. All drill holes would be grouted, monitoring and temporary water supply wells properly abandoned, and temporary water use permits allowed to expire. Minimal groundwater impacts would occur in the villages of Iliamna, Nondalton, and Newhalen because groundwater use for water supply would continue. Groundwater along the Transportation Corridor, Pipeline Corridor, and at the Amakdedori Port would remain in its current state. There are no known wells in the Transportation Corridor or at the Amakdedori Port site. There would be no effects on existing private wells near the Kenai Peninsula terminus of the Natural Gas Pipeline Corridor. In summary, there would no direct or indirect impacts on groundwater from implementation of the No Action Alternative.

4.17.2 Alternative 1 – Applicant's Proposed Alternative

4.17.2.1 Mine Site

Pit Dewatering

Construction of the open pit would require lowering groundwater levels in the pit area through dewatering to establish stable pit walls and provide dry working conditions. Although a specific dewatering design has not been developed at this point, dewatering is typically accomplished by placement of dewatering wells around the proposed pit perimeter; wells in the pit bottom as mining progresses; and horizontal drains along the pit walls. Dewatering results in a groundwater "cone of depression" because the water table is lowered in the pit, and extends beyond the pit extent into the adjacent bedrock, glacial, and alluvial aquifers. The cone of depression would deepen and widen as pit excavation progresses, and would last as long as the dewatering system is operated during construction and operation of the mine. The final open pit is estimated to be approximately 6,000 feet in diameter. Groundwater levels would ultimately need to be lowered below the base of the final mine pit depth, which is estimated to be up to

1,750 feet below grade. The number of dewatering wells and drains required to dewater the proposed pit and the expected impacts on groundwater and surface water in the proposed pit area would be estimated using the calibrated groundwater flow model being developed for the Mine Site.

Creation of a cone of depression around the proposed pit would locally change groundwater flow patterns so that groundwater flows radially towards the pit, which acts as a groundwater "sink" while dewatering occurs. Groundwater/surface water interactions and surface water flows would also be impacted by pit dewatering. Groundwater discharge to seeps, springs, streams, ponds, or lakes in or adjacent to the proposed pit may cease or be reduced, resulting in lower surface water base flows or pond or lake levels. Some stream segments, ponds, or lakes in the immediate pit area may be eliminated as the water table is lowered in the immediate pit area during construction and mining operation.

The Pebble deposit straddles a watershed and groundwater divide between the headwaters of the Upper Talarik Creek and South Fork Koktuli River. Groundwater dewatering impacts are expected to be largely confined within the upper reaches of the South Fork Koktuli River basin, but may locally impact groundwater flow across the divide within the bedrock aquifer from the headwaters of the Upper Talarik Creek basin, depending on the extent of the cone of depression around the pit. The primary groundwater flow impacts would be in the alluvial, glacial, and bedrock aquifers in the open pit footprint. Groundwater flow in these aquifers would radially flow towards the pit, and be captured by the dewatering system. The groundwater impact would grow as mining proceeds to depth, and the cone of depression surrounding the pit becomes wider and extends to depth.

[Note: Quantitative estimates of the likely impacts of dewatering on the groundwater and surface water flow systems within the South Fork Koktuli River and Upper Talarik Creek basins will be added to the above text when the revised groundwater model results are available in response to RFI 019].

Once mining ceases, groundwater in the open pit would be allowed to slowly rise, resulting in a permanent pit lake. Groundwater flow into the pit would initially be fast, but would slow as water level rises. It would likely take tens of years for the groundwater in the pit to attain the level at which the groundwater would then be maintained to create a permanent groundwater sink to prevent potentially acidic pit lake water from discharging to the environment. The presence of a permanent groundwater sink at the pit would locally influence groundwater flow in the immediate vicinity of the pit; however, the influence on groundwater flow would be less than the pit in its fully dewatered state. [Note: Quantitative estimates of the likely impacts of the pit lake on the groundwater and surface water flow systems in post-closure will be provided when the revised groundwater model results are available in response to RFI 019.]

Drinking Water Wells

Potable water would be supplied by a series of groundwater wells north of the Mine Site, outside of the estimated cone of depression around the proposed open pit. The wells would be pumped at a rate to provide sufficient potable water for Mine Site personnel living and working at the site. The potable water supply wells would also be used for fire-fighting if needed. The potable water supply wells are expected to have much less local impact on groundwater flow, compared to the open pit dewatering. [Note: Quantitative estimates of the likely impacts of pumping the potable water supply wells on groundwater flow at the Mine Site will be provided when additional information on water supply pumping rates and revised groundwater model results are available in response to RFI 019].

Water Management Ponds

Water Management Ponds (WMPs) would be constructed at the Mine Site to manage water removed during pit dewatering, manage water from the milling and concentrating operations, and manage surface water runoff from the Mine Site. These ponds would be lined to prevent leakage of water with potentially elevated particulate and constituent concentrations. Water in these ponds would be treated as needed and used in the milling operations. The water may also be used in tailings disposal operations. Surplus water would be treated to discharge standards and released downstream of the Mine Site to maintain water balances in the streams draining the mine site. The WMPs are expected to have no adverse impact on groundwater flow, because they would be lined to prevent leakage of water to the subsurface. The WMPs may help restore downgradient groundwater flow to existing conditions as surplus water is treated and discharged downstream of the Mine Site.

Tailings Storage Facilities

Non-acid generating bulk flotation tailings generated during milling operations would be stored in an unlined bulk tailings storage facility (TSF) at the Mine Site. The TSF would be constructed in the North Fork Koktuli watershed, with a series of embankments to impound the tailings and entrained and ponded water; and an underdrain system to manage seepage water draining from the tailings. The thickened bulk flotation tailings discharged to the TSF would settle, and water would be collected in a tailings decant pond. Seepage water draining from the tailings would be collected by the underdrain system, and routed to a lined seepage control pond. Water collected in the seepage control pond would be used for tailings dust control, or transferred to the water management ponds for subsequent use in milling and concentrating operations. Surplus water would be treated to discharge standards and released downstream of the Mine Site to maintain stream water balances. Construction of the TSF would locally impact surface water features at the site, and potentially impact groundwater/surface water interactions; this impact is expected to be small in extent (e.g., near the vicinity of TSF) but permanent. Although the underdrain system is expected to minimize vertical seepage into native materials below the TSF, the largest potential impact to groundwater beneath the TSF would result from tailings seepage with elevated constituent concentrations that is not captured, and is released to the underlying groundwater, thereby impacting local groundwater quality. (Impacts to groundwater quality are further discussed in Section 4.18, Water and Sediment Quality.) Tailings seepage that is not captured could create a local groundwater mound beneath the TSF that could have a local influence on groundwater flow.

The potentially acid-generating (PAG) pyritic tailings and PAG waste rock would be stored submerged in a separate lined impoundment to minimize oxidation and the potential release of acidic contact waters to the environment. Groundwater flow would be minimally impacted by the construction of this impoundment through local reduction in recharge through the liner. The pyritic tailings would be placed at the bottom of the open pit at the end of mining, and submerged in the pit lake to prevent oxidation. The pyritic tailings storage impoundment liner and embankments would be removed at closure and the site reclaimed to its approximate pre-mining state. Therefore, groundwater flow in this tributary drainage is expected to return to pre-mining conditions post-closure.

[Note: Above text to be revisited following receipt of revised project footprint and Water Balance Model in response to RFI 019.]

4.17.2.2 Amakdedori Port

Shallow Groundwater Interception

Minor excavations across the port footprint may be required during construction activities. Due to the apparent high water table in the area, which is likely hydraulically connected to Amakdedori Creek, some excavations could intercept shallow groundwater. Impacts would likely be limited to within the port footprint and would occur only during construction activities.

Groundwater Use

Based on limited hydrogeologic information at the port site, shallow glacial and fluvial sediments in the area are likely to host groundwater (Glass 1999). Although no details have been provided on project-related groundwater use at the port, a well may be needed to supply potable water for port personnel and/or fresh water for operations. It is anticipated that such a well would have a local impact on groundwater flow and quantity resulting from drawdown caused by pumping. The duration of impacts would be long-term, lasting through the life of the project. Depending on location and pumping rates, the potential exists for saltwater intrusion into the well. [Note: An RFI is under development for information regarding potential groundwater use at the port; above text to be revised following receipt.]

4.17.2.3 Transportation Corridor

Shallow Groundwater Interception

The Transportation Corridor is designed to avoid wetlands and stream crossings where feasible, and its alignment would be optimized for the most favorable soil and geotechnical conditions. Local groundwater flow impacts may occur along the corridor where the roadway is constructed across wetlands that may be supported by groundwater inflow.

Some road segments would likely require road cuts to maintain proper road grade. These are represented by wide areas of the road footprint on hillslopes (PLP 2017: Figures T-001 through T-046), which are prevalent throughout much of the access and spur road corridors. Due to the likelihood of shallow groundwater being present across the road corridor, it is possible that road cuts could intersect groundwater in some areas and cause a local effect on groundwater flow as drainage controls direct potential seepage away from the road.

Water Use

Substantial surface water/groundwater interaction from project water use is likely along much of the corridor, as demonstrated farther north in the Mine Site. Approximately 50 million gallons of surface water would be extracted from 21 water extraction sites along the road corridor, mostly for use in road construction activities (RFI 022 response). This water would be extracted across the entire road corridor over months to years of construction. Due to the abundance of groundwater in the region, the extraction of surface water for road construction would not likely have measurable impact on groundwater flow or other uses.

4.17.2.4 Natural Gas Pipeline Corridor

Shallow Groundwater Interception

Although no specific studies have been conducted on hydrogeology along most of the pipeline corridor, the water table is likely close to the surface along most of the corridor, as evidenced by abundant wetlands and kettle ponds. Groundwater along the corridor is likely held in shallow aquifers of glacial sediment, as demonstrated in similar geologic terrain at the Mine Site. Therefore, a large percentage of the buried pipeline could intersect shallow groundwater.

[Note: Additional stream crossing and wetlands investigations will be completed in summer 2018 along the south corridor. This section will be revised with related hydrogeologic information, if available, following completion of field reports.]

The pipeline would be buried a minimum of 5 feet beyond the road shoulder, and placed in a trench extending to a depth of 4 feet (minimum). Potential impacts to groundwater would likely involve interception of shallow groundwater during trenching activities, which could be captured and locally routed along the trench backfill. Modifications to groundwater flow would occur mostly in the immediate vicinity of the trench. Impacts could extend beyond the life of the project, because the pipeline would be abandoned in place. Low-permeability trench plugs, considered a typical best management practice for pipeline installation (e.g., USACE 2018), would likely be installed to minimize movement of groundwater along the trench, internal erosion, and alteration of the natural flow of groundwater.

Potential contamination of groundwater could occur during pipeline construction, when heavy machinery and trenching equipment would likely be operating in close proximity to the water table. Section 4.18, Water and Sediment Quality, describes potential impacts of project activities on groundwater quality.

<u>Horizontal Directional Drilling</u>

On the Kenai Peninsula, the pipeline would be trenched for a short distance west of the compressor station, then installed by horizontal directional drilling (HDD) at the shoreline and into Cook Inlet from an elevation of about 200 feet to -12 feet mean lower low water (RFI 011 response). Groundwater is present in this area in aquifers in thick glacial and alluvial deposits, and Tertiary sedimentary bedrock. Although the exact depth to groundwater is unknown at the HDD location, nearby wells drilled at similar elevations to the HDD work area encountered shallow water-bearing glacial deposits at depths between 8 and 30 feet below ground surface, as well as deeper aquifers in both glacial deposits and sedimentary bedrock units between 50 and 120 feet deep (USGS 1967; Nelson and Johnson 1981; ADNR 2018). Therefore, the HDD installed pipeline segment would likely intersect these aquifers, which are used near the project footprint by private wells (Figure 3.17-12).

Plans for control of groundwater during HDD drilling are currently unknown. Typical effects might include dewatering during drilling; pressurization of the hole, forcing drilling fluids into aquifers; and discharge of pumped groundwater (e.g., TRCA 2013). Dewatering, if required, could draw down the local water table, potentially changing local flow patterns and affecting other uses. If discharge of dewatering water is necessary, impacts to surface water, wetlands, and soils could occur if discharge water is not treated effectively, or if dissipation methods are not employed to minimize erosion. These effects are expected to be temporary, recovering days or weeks after construction, and localized in the near vicinity of the footprint, depending on drawdown extent and potential discharge location. [Note: An RFI is under development regarding proposed HDD drilling practices. The above text will be revised following response. Mitigation measures may be added to Chapter 5 if warranted.]

4.17.2.5 Cumulative Effects

[Note: This section will be updated at a later time.]

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4.18 WATER AND SEDIMENT QUALITY

This section describes potential impacts of the project on surface water quality, groundwater quality, and sediment quality. The following discussion is based on currently available information and will be updated as further project details are available.

4.18.1 No Action Alternative

The geologic material at the Mine Site would continue to weather in place naturally. Background water and sediment quality in the vicinity of the Mine Site would not change, and would still contain certain constituents in amounts exceeding regulatory levels because of natural mineralization and geochemical weathering processes. Water quality along the Transportation and Natural Gas Pipeline corridors would continue to reflect the presence of elevated levels of some constituents as described in Chapter 3, Affected Environment. Sediment would continue to contain certain constituents (e.g., metals) at elevated levels. No project-related geochemical processes or impacts on surface water, groundwater, or sediment quality would occur under this alternative. Consequently, under the No Action alternative, the project would not be constructed, and would not have any new effects on water and sediment quality.

4.18.2 Alternative 1 – Applicant's Proposed Alternative

4.18.2.1 Mine Site

The construction phase would consist of dewatering of the pit area and removal of overburden that would be stockpiled. Dewatering would begin approximately one year before the start of operations. Approximately 1,300 million tons of mineralized rock (ore) and 200 million tons of waste rock would be excavated from the open pit (PLP 2018). Non-acid-generating waste rock would be used in construction of the tailings embankments and Mine Site roads. The pyritic tailings and potentially acid-generating (PAG) waste rock would be stored subaqueously until closure, when it would be transferred to the open pit lake.

Surface Water Quality

The main objective of water management at the Mine Site is to manage water originating in the project area in an environmentally responsible manner while providing an adequate water supply for operations. A primary design consideration is to ensure that all contact water requiring treatment before release to the environment would be effectively managed. This includes carefully assessing the layout of project facilities, process requirements, the area's topography, hydrometeorology, aquatic habitat and resources, and regulatory discharge requirements for managing surplus water.

All runoff water contacting the facilities at the Mine Site and water pumped from the open pit would be captured to protect overall downstream water quality. The final project design would incorporate a detailed analysis of water collection and management, including quantity and quality estimates, water treatment options, water management facility design, and strategic discharge of treated water. Implementation of the water management plan would enable the plant to operate without additional water from off-site sources.

Construction Phase – Water Management and Treatment

Implementation of the water management plan during the pre-production phase can be summarized as follows:

- Water diversion, collection, and treatment systems would be installed to address the effects of ground disturbance during construction.
- Water management and sediment control structure best management practices (BMPs), including temporary settling basins and silt fences, would be installed to accommodate initial construction at the Mine Site.
- Among the first permanent facilities to be constructed would be water management structures that would be maintained for use in adaptive management during operations. These structures would include diversion and runoff collection ditches to minimize water contact with disturbed surfaces, and sediment control measures such as settling ponds to prohibit sediment from reaching downstream water bodies.
- The pre-production phase could not commence until the proposed open pit dewatering system lowers the groundwater table in the area of the open pit. Lowering the groundwater table would allow the uninterrupted removal of overburden in the open pit area in preparation for production mining of mineralized material. The dewatering system comprises a series of dewatering wells drilled into and around the perimeter of the open pit. The specific number of wells and their locations would be determined by testing the overburden aquifers, and would include an allowance for wells with poor or no water yields and wells lost through sanding, equipment loss, or other interference with water production. Pump sizes for each well would be based on well-specific yields. Water collected from the pit dewatering wells would be discharged to the environment if it meets water quality criteria; otherwise, this water would be treated in a modular water treatment plant (WTP) before discharge.

Operations Phase – Water Management and Treatment

[Note: RFI placeholder: Text regarding production phase will be revised as needed based on additional project information through RFI 019, including the water management plan.]

During operations phase, implementation of the water management and sediment control plan would focus on minimizing contact water. Runoff and associated sediment control measures would be managed with BMPs and adaptive management control strategies. Where water could not be diverted, it would be collected for use in the mining process or treated and discharged.

Water collected from the pit dewatering wells and the open pit during the production phase would be pumped to the open pit water management pond (WMP). From there, water would be pumped to the open pit WTP for treatment and discharge.

Bulk and pyritic tailings slurry from the mill would be directed to the bulk tailings storage facility (TSF) and the pyritic TSF, respectively. In addition, precipitation and runoff water would collect in the bulk TSF. The bulk TSF would maintain a small operating (supernatant) pond while the pyritic tailings would remain fully submerged in the pyritic TSF. Excess water from the pyritic TSF would be pumped to the bulk TSF. The main embankment at the bulk TSF would operate as a flow-through facility. Water collecting in the bulk TSF would flow through the embankment to the main embankment's seepage collection pond. From there, water would be directed either to the main WMP for use in the mill or to the main WTP for treatment and discharge. Excess surface water in the bulk TSF would be similarly managed.

Contact water would be pumped to the main WMP. Water treatment byproduct sludge and reject water (water resulting from the treatment process) would be directed to the process plant and added to the pyritic TSF via the pyritic tailings slurry line. A portion of the treated water from the main WTP would be returned for use in the process plant and power plant cooling towers.

A water surplus is anticipated during the operations phase under normal and wetter than normal climatic conditions. Although the Mine Site would have a water surplus, the volume of water available for discharge would be less than pre-mine flows within the mine footprint, because some water would be consumed in the tailings voids and some would be lost to evaporation and other minor uses. The site's water surplus would vary during operations as the mine footprint expands and additional site runoff is collected. The annual average surplus is estimated at approximately 39 cubic feet per second for the maximum mine footprint. Surplus water would be treated and discharged throughout the year.

Minimal water storage capacity would be available at the Mine Site until the completion of initial construction activities. Therefore, before the bulk TSF embankments and water management structures are completed, all water not meeting water quality standards would be treated and released. Water from the following sources and activities is expected to require treatment before release:

- Water present during pre-production phase pit dewatering. (Dewatering of the overburden aquifer near the pit may require treatment
- Water, primarily from precipitation, that accumulates in the open pit during pre-production phase mining
- Runoff from construction of TSF embankments.

Runoff from excavation for site infrastructure such as the process plant, camps, power plant, or storage areas would be routed to settling ponds before release.

Before the operations WTPs are brought online, modular WTPs would be used to treat contact water not meeting discharge requirements.

[Note: The discussion of water treatment plant flows will be revised as needed following receipt of a response to RFI 019, including the water management plan.]

[Note: The response to RFI 020 (Water Treatment) includes benchmarking studies summarizing information on typical water treatment plants using technologies proposed for the project. These studies are not specific to the current project and were used as general guidance for the following text. The text will be revised following receipt of a response to RFI 021 (Water Quality Predictions at the Mine Site) and project-specific water treatment plans.]

During the production phase, the Mine Site would have two WTPs: the main WTP and the open pit WTP. Both would be constructed with multiple, independent treatment trains, which would enable ongoing water treatment during mechanical interruption of any one train.

[Note: The following summaries of WTPs are based on PLP 2017 and will be revised based on updated project plans. Text will be revised following responses to RFI 019 and RFI 021.]

Main Water Treatment Plant

The main WTP would treat water from the bulk TSF main embankment seepage pond WMP. Key treatment steps would occur in the following sequence:

1. Dissolved metals would be oxidized with air, ferric sulfate, and potassium permanganate, followed by co-precipitation with lime. Flocculators/clarifiers would be used to separate out the co-precipitated solids.
2. The clarified water would flow into a membrane feed tank, where sodium hydrogen sulfide or an organosulfide would be added to complete the precipitation process. Supplemental lime and sulfuric acid would be added as needed to maintain the water pH for optimal precipitation and membrane feed.
3. Ultrafiltration membranes would be used to filter precipitated metals and protect downstream high-pressure membranes.
4. High-pressure membranes (either nanofiltration, reverse osmosis, or a combination) would provide additional removal of metals and removal of calcium, magnesium, and sulfate. Filtrate from the high-pressure membranes may require an alkalinity adjustment before discharge.
5. Reject from the high-pressure membranes would have a high concentration of sulfate and other divalent ions. To prevent overloading the mine water balance with sulfate, some sulfate must be removed from the reject before its disposal in the TSF. Sulfate would be removed with a multi-stage calcium sulfate precipitation process. Precipitated calcium sulfate solids would be disposed of in the TSF.
6. Decant from the calcium sulfate precipitation process would contain high levels of selenium, nitrate, sodium, and potassium. It would be necessary to split the decant stream to treat selenium and nitrate separately from sodium and potassium as follows:
   A. Approximately half of the decant stream would be sent to a biological reactor to remove selenium and nitrate, followed by filtration. The filtrate would be blended with treated water from the high-pressure membranes (step 4) for discharge.
   B. The remainder of the decant stream would be sent to a multi-stage reverse osmosis system to remove sodium and potassium. Reverse osmosis filtrate would be blended with treated water from the high-pressure membranes (step 4) for discharge. Concentrated reverse osmosis reject (reject water) sent to an evaporator to remove sodium and potassium as a solid. The evaporate would be condensed and the condensate blended with treated water from the high-pressure membranes (step 4) for discharge.

Open Pit Water Treatment Plant

The open pit WTP would treat water from the open pit WMP with treatment plant processes commonly used in the mining industry around the world. Key treatment steps would occur in the following sequence:

1. Dissolved metals would be oxidized with potassium permanganate, followed by co-precipitation with ferric chloride. Sodium hydroxide and hydrochloric acid would be added as needed to maintain the water pH for optimal precipitation. Flocculators/clarifiers would be used to separate out the co-precipitated solids.

2. Clarified water would then be treated with sodium hydrogen sulfide, sodium hydroxide, and ferrous sulfate to further co-precipitate remaining metals under reducing conditions.
3. Water from the sulfide reaction tanks would be filtered to remove precipitated metals. The filtered water would be suitable for discharge.
4. Clarifier solids and filter backwash would be thickened and transferred to the TSF.

Closure/Post-Closure Phase – Water Management and Treatment

Closure and post-closure water management would address both the physical closure of the site and associated reclamation activities, as well as the long-term post-closure period and associated maintenance and monitoring activities. [Note: Text describing closure/post-closure water management will be revised following receipt of a response to RFI 019 and the water management plan.]

The current water management plan for the closure and post-closure phases is generally described below.

Once mining ceases, dewatering would also stop, the groundwater level in the pit would begin to rise to create the pit lake, and site reclamation would commence. Surface runoff from the reclaimed areas would be collected and either treated in the WTPs or directed to the pit lake until the runoff is determined to be suitable for direct discharge. Free water would be pumped from the surface of the bulk TSF, which would be graded and revegetated to direct surface runoff toward the closure spillway. Pyritic tailings and PAG waste would be moved into the pit. Seepage water from the embankment seepage collection systems would be collected and either treated in the WTPs or directed to the pit lake until it is determined to be suitable for discharge.

Surface runoff into the pit lake could cause metals to leach from the pit walls. Water quality in the pit lake would be expected to be acidic, with elevated concentrations of some metals caused by the oxidation of sulfide compounds in the pit walls and the natural concentrations of metals found in the mineralized rock. Once the level of the pit lake has risen to about 890 feet above mean sea level, water would be pumped from the pit, treated as required, and discharged to the environment. With the pit water level maintained at least 50 feet below the natural groundwater level, the pit water would be retained in the pit and would not contribute (flow out) to affect the quality of the shallow groundwater. [Note: RFI Placeholder – RFI 019. Text will be revised following receipt of a response to RFI.]

Water treatment during closure/post-closure would use the existing WTPs as needed. Water quality would be monitored, and changes and adjustments to the treatment process would be made as needed. The reclamation plan and closure bond package required by the State of Alaska would include provisions for periodic replacement of water treatment facilities and ongoing treatment operating and monitoring costs over the long-term, post-closure period. [Note: RFI Placeholder – RFI 021, RFI 019, including water management plan. Text will be revised following receipt of a response to RFI.]

Process-related (contact) water would not be considered waters of the United States or subject to the Alaska Pollutant Discharge Elimination System (APDES) permitting program while such water is retained within the water management facilities. Contact water would be retained and treated as necessary to meet regulatory criteria before discharge.

Contact water collected in certain mine facilities is not expected to meet Alaska water quality criteria (18 Alaska Administrative Code 70, Water Quality Standards) (ADEC 2018) for discharge and would not be released directly to the environment. Contact water would be treated to ensure compliance with the most stringent applicable water quality standards before being discharged to the environment. The geographic extent of impacts on surface water quality attributable to contact water would be limited to the areas used for contact water storage before treatment. Because the contact water would first be treated to comply with the most stringent applicable water quality standards, the activities proposed under Alternative 1 are not expected to result in impacts on surface water quality.

Groundwater Quality

[Note: The following text is under development and will be revised following receipt of the revised groundwater model, water management plan, and water quality modelling in RFI 019 and 021 responses.]

The affected environment with respect to groundwater flow and quality is addressed in Section 3.17, Hydrogeology, and Section 3.18, Water and Sediment Quality, respectively. With an effective water management and water treatment program, impacts on groundwater quality would be limited to discrete portions of the project area. The principal mechanisms responsible for potential effects on groundwater quality at the Mine Site are currently under evaluation. A summary of a preliminary evaluation of Mine Site facility concepts is presented below.

Groundwater that could be contaminated by vertical seepage from the unlined bulk TSF would flow north down the North Fork Koktuli River (NFK) west drainage and would be captured by the main embankment seepage collection pond. Groundwater would be less likely to be contaminated beneath the pyritic TSF /PAG waste rock facility and the main WMP, because these facilities would be fully lined. Any leakage through the liners would flow north down the NFK east drainage and would be intercepted by the downgradient sediment pond or other seepage collection systems (currently under development). The spatial extent of these impacts is expected to be limited to shallow groundwater between the TSFs and seepage collection facilities. The TSFs and PAG storage facilities are not expected to result in impacts on downgradient groundwater quality outside of the Mine Site, based on understanding of current seepage collection design features. However, impacts on local groundwater could be sufficient to exceed water quality regulatory criteria, and could persist through the life of the mine and well into post-closure, until monitoring at seepage collection systems indicates that water quality meets the approved criteria for discharge.

Inputs of contaminated water from the pit to groundwater after the cessation of pit depressurization could potentially exceed regulatory limits for water quality. During the early closure period after pit depressurization ceases and the lake level rises, concentrations of several constituents of concern would be expected to increase in the groundwater surrounding the pit. These effects are expected to be localized and hydraulic containment maintained during this period, because of overall flow gradients toward the pit area. After the early closure period, groundwater would flow toward the pit lake radially from all directions, thereby limiting the extent of migration, and ultimately recapturing any pit-contaminated groundwater and restricting the spatial extent of the impact. After lake level rise, groundwater gradients toward the pit would be maintained by managing the pit lake level through pumping and treating lake water in perpetuity. [Note: The possibility of regional groundwater flow away from the pit has not been addressed in project documents to date. The above text will be revised, and anticipated changes to groundwater flow determined, upon receipt of groundwater model in RFI 019 response.]

Groundwater is abundant in the project area and would be used as a source of potable water. The proposed water supply wells would be sited on a groundwater high located upgradient, and on the north or opposite side of the NFK east drainage, which would contain seepage collection systems for the pyritic/PAG storage area and main WMP. Thus, groundwater potentially affected by Mine Site facilities would not be expected to affect sources of drinking water to be used by on-site workers.

Disruption, in-filling, and removal of wetlands could influence groundwater recharge and discharge patterns, which could affect groundwater quality in the vicinity of the Mine Site. Currently, although sulfides appear to be oxidizing in the deposit area, the groundwater is not acidic (see Section 3.18 in Chapter 3). Reducing conditions are prevalent, partly because of deposition of organic carbon from wetlands and infiltration of organic carbon during spring thaw. The redox state of the overburden is not expected to change during mine operations; however, concentrations of metals in shallow groundwater may increase because of disruption of wetlands and increased sedimentation.

Impacts on groundwater quality from Mine Site activities proposed under Alternative 1 would likely be limited to effects on local groundwater in the near vicinity of mine facilities and would remain within the Mine Site boundaries. These impacts would be such that groundwater would not meet regulatory criteria at certain discrete locations within the Mine Site (e.g., shallow groundwater beneath the TSFs and groundwater near the pit during lake level rise). Groundwater quality beneath the NFK west and NFK east drainages would likely be reduced during the life of the project, but would be expected to improve in the decades after mine closure. Groundwater entering the pit where it would mix with pit lake water would be essentially pumped and treated in perpetuity. [Note: Text to be revised following receipt of water quality and groundwater modeling results and the water management plan in RFI 019 and 021 responses.]

Sediment Quality

Processes of mining and exposing rock to chemical and physical weathering and erosion may increase the natural (pre-mine) rates of these processes, and thus release some of the constituents into the surrounding surface water and substrate. Chemical components in water can be absorbed by sediment or adsorbed onto sediment surfaces. Conversely, sediment can retain chemical constituents and slowly release them into the water. Therefore, the evaluation of impacts on sediment quality largely depends on water quality, as well as other direct sedimentation impacts (e.g., erosion, dust). Impacts to sediment quality from surface disturbances would be limited to portions of the project area through containment and implementation of BMPs.

[Note: This section will be further developed based on response to RFI 019, including the water management plan and RFI 021, Water Quality Predictions at the Mine Site].

4.18.2.2 Amakdedori Port

Amakdedori Port would be the shoreline hub for shipping, receiving, and storage of concentrate containers, fuel, reagents, and other freight for the project. The port site would include power generation and distribution facilities, maintenance facilities, employee accommodations, and personnel offices. The Port Terminal building would be constructed on an engineered fill patio, designed to be at an elevation high enough to avoid tidal surge from major storms. Port infrastructure should be built above the 100-year floodplain of Amakdedori Creek, although the floodplain is not well defined.

Surface Water Quality

The WTP at Amakdedori Port would treat surface runoff from the port facilities. The treatment process would include dissolved metal oxidation using potassium permanganate, followed by co-precipitation with ferric chloride. Water from the co-precipitated solids would flow into flocculators/clarifiers to separate out solids. The clarified water would then be treated with sodium hydrogen sulfide, sodium hydroxide, and ferrous sulfate to further co-precipitate the remaining metals under reducing conditions. The solids removed would be thickened and disposed of appropriately. The treated water would be suitable for discharge. A potable WTP and a sewage treatment plant would also be located at the port site.

Deposition of dust from concentrate handling at the port site and the offshore loading of bulk carriers has the potential to result in impacts on surface water quality in Cook Inlet; however, such impacts could be mitigated, and possibly eliminated, by implementing BMPs to prevent the dust from entering the water. The nature and extent of dust-related impacts at the port site, and the efficacy of proposed mitigation measures will be analyzed in greater detail as more information becomes available.

Groundwater Quality

No impacts on groundwater quality are expected to occur at the port site.

Sediment Quality

Sediments in waterbodies at the port site could potentially be affected by erosion, dust deposition, and overland runoff, especially during construction. BMPs would be in place to avoid or minimize the effects of construction of the port facilities.

4.18.2.3 Transportation Corridor

Surface Water Quality

Impacts on surface water quality in the Transportation Corridor could result from occasional barge/tug-induced suspended sediment, or from erosion effects at construction sites. Erosion and sedimentation would be managed by implementing BMPs. Based on the response to RFI, no material sites proposed for the project are sources of PAG material. If PAG is identified during the site evaluation before use, the material site would not be used.

Sediment Quality

Sedimentation along the Transportation Corridor is possible during construction such as vegetation removal, excavation, grading, and other ground-disturbing activities. Eroded soils and sediments may then be transported by water and wind, potentially causing sedimentation in nearby waterbodies. Sedimentation during road construction would likely be confined to the area within the construction right-of-way. See Section 3.24, Fish Values, for information on erosion impacts to fish and aquatic resources, and Section 3.26, Vegetation for information on acres of vegetation removal. [Note: This text will be updated to address results of summer 2018 substrate sampling and analysis of fish-bearing surface water bodies along the Transportation Corridor requested as RFI 036.]

Erosion and sedimentation would continue for the life of the unpaved roads. BMPs would include dust control and erosion and sedimentation control measures to avoid or minimize the potential impact on waterbody substrate during construction and operation of the roads.

Withdrawal of water from permitted waterbodies during construction and operation along the Transportation Corridor has the potential to disturb fine sediments on streambeds and lakebeds, causing increased erosion, turbidity, and sedimentation in the waterbodies and downstream. Implementing BMPs and complying with permit stipulations for water extraction methods would avoid or reduce impacts on sediment.

4.18.2.4 Natural Gas Pipeline Corridor

Surface Water Quality

Under Alternative 1, the primary impacts on surface water quality within the Natural Gas Pipeline Corridor would be associated with installation of the natural gas pipeline at water crossings, and the use of local water sources for hydrostatic testing. Impacts at material sites would be the same as those described above for the Transportation Corridor.

ADEC water quality standards for fresh water streams specify that turbidity levels may not exceed five nephelometric turbidity units (NTU) above natural conditions when the natural turbidity level is 50 NTU or less. When natural turbidity is more than 50 NTU, the turbidity level may not increase by more than 10 percent, not to exceed a maximum increase of 15 NTU.

Surface water quality at stream crossings along the pipeline corridor would be expected to be within this water quality standard during construction. Isolated occurrences of impacts above this standard could occur (e.g., during high-precipitation periods along summer construction segments), but are expected to be reduced within a short time frame because of planned redundancies in BMPs, erosion and sediment control measures, and reclamation/cleanup crew functions.

The extent of potential impacts from hydrostatic testing for pipeline pressure testing would be limited because water volumes required for hydrostatic testing would be small compared to the volumes of potential sources from rivers and small lakes along the route. Impacts on surface water quality would likely be imperceptible. Discharges of hydrostatic test water would meet the requirements of the applicable APDES general permit.

Sediment Quality

Potential impacts on waterbody substrate from sedimentation and erosion would be similar to those described above for the Transportation Corridor. BMPs would be in place to control runoff and erosion during trenching and backfilling and other ground-disturbing activities; therefore, impacts would be avoided or minimized.

[Note: This text will be updated to address results of summer 2018 substrate sampling and analysis of fish-bearing surface water bodies along the Transportation Corridor requested as RFI 036.]

4.18.2.5 Cumulative Effects

[Note: This section will be updated at a later time.]

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Note to Reviewers

This section is an early stage preliminary draft, and has been prepared prior to the completion of scoping for the purpose of setting analytical direction and facilitating the project schedule for completing the EIS.

As an initial draft, it is incomplete in many ways, and contains numerous placeholders to be addressed as more information becomes available. The Scoping Comment Period has not closed, Alternatives to the Proposed Action have not been formally identified, information needed to complete the analysis is not yet fully available and in the process of being requested from the applicant, and the approach for topics such as spills/dam failures, traditional knowledge and cumulative effects has not been settled. In addition, supporting analysis and logic for determination of potential environmental consequences have not been fully developed. This draft is intended to frame the eventual section, and in doing so, allow USACE to see the intended topics and content for the eventual completed sections. Notes are included in many sections to identify where the analysis is incomplete.

4.22 WETLANDS/SPECIAL AQUATIC SITES

The project has the potential to result in the following direct and indirect effects to wetlands/special aquatic sites and waterbodies (henceforth, referred to as "wetlands"):

- Direct impacts from removal of wetland vegetation and soil
- Indirect impacts from:
  - Disruption of wetland hydrology
  - Alteration of surface water quantity or distribution
  - Alteration of subsurface water quantity and distribution
  - Erosion and sedimentation.

Project impacts have been assessed by watershed to place the impacts in an ecological context. U.S. Geological Survey (USGS) Hydrologic Unit Code Tenth Level (HUC10) watersheds have been used for this purpose, and define the environmental impact statement (EIS) analysis area for wetlands. Impact assessments were considered, analyzed, and determined from the perspective of overall regional Alaskan vegetation affected. To contextualize project impacts, the analysis for vegetation applied publicly available environmental data for the EIS analysis area for the nine HUC10 watersheds that could potentially be directly or indirectly affected.

The magnitude of impacts to wetlands were assessed in terms of percent of disturbance area to high-value wetlands or greater proportions of low-value wetlands in the EIS analysis area. Magnitude would be less for disturbance areas below five percent, and would be greater for disturbance areas above five percent, with greatest intensity for disturbance areas above 25 percent. Some areas of wetlands would be reclaimed, and some would not. The duration of impacts would be temporary, meaning wetland functions would be reduced during the construction phase; or permanent, meaning reduction or elimination of wetlands functions would occur after the construction phase, through the operations and into the closure and post-closure phase. The extent of impacts would be limited to areas of the project area in which wetlands would be removed or disturbed, or would affect wetlands outside of the project area, within one or more HUC 10 watersheds.

To assess the relative magnitude and extent of impacts, the relative proportion of common wetland types in each watershed was estimated. The National Wetland Inventory (NWI) mapping covers only about one-fourth of the watershed area, and was therefore not sufficient for this effort. The uniform vegetation mapping provided by the Alaska Center for Conservation Science (ACCS) provided the best available spatial data for estimating wetland coverage for the HUC10 watersheds.

Vegetation class descriptions from the Vegetation Map and Classification guidebooks (Boggs et al. 2016a, 2016b) were reviewed. Vegetation classes mapped in the watersheds were assigned to one of the following types in a crosswalk for comparison with wetlands mapped for the project: upland, forested wetland, shrub wetland, herbaceous wetland, aquatic bed wetland, or waterbody.

The descriptions of herbaceous vegetation classes included wetland status; therefore, these vegetation classes were directly crosswalked to herbaceous wetland or upland. The woody vegetation classes lacked wetland status, so it was not possible to directly crosswalk types. Because forested vegetation types were uncommon, an assignment was made for each mapped unit based on site characteristics.

Shrub vegetation classes were common; a shrub vegetation class was assigned to wetland or upland based on a review of site characteristics. The dwarf shrub class in particular was not broken out in the mapping to differentiate dry sites from wet sites. Therefore, the acreages and percentages for each watershed are used here for comparison purposes, and should be considered an approximation of the actual extent of wetlands.

4.22.1 No Action Alternative

Under the No Action Alternative the Pebble Project would not be constructed, and no new impacts to wetlands would occur.

4.22.2 Action Alternative 1 – Applicant's Proposed Alternative

4.22.2.1 Mine Site Direct Impacts

[Note: Section to be revised with updated numbers and descriptions based on updated project description.]

[Note: Temporary versus permanent impacts will be refined in all text and tables pending an updated project description].

Most project-related direct impacts to wetlands would be initiated during the construction phase and would result in temporary or permanent loss of wetlands or alteration in wetland functions. Primary direct construction-related impacts to wetlands and waterbodies would include:

- Clearing and removal of wetland vegetation
- Placement of fill in wetlands and waterbodies
- Excavation that eliminates wetlands and waterbodies
- Compaction, rutting, and mixing of wetland soils.

Excavation of the open pit, quarries, and sediment ponds and filling within the tailings storage facility (TSF) and stockpiles would occur throughout the active life of the mine. The maximum extents of all surface disturbance impacts were used to evaluate direct wetlands impacts for the Mine Site. Some wetland reclamation would begin shortly after the start of construction and would continue throughout operations and closure.

A total of 3,191 acres of wetlands and waterbodies would be directly affected by the proposed Mine Site facilities (Table 4.22-1). The greatest impacts would occur from the bulk tailings storage cell (1,083 acres), the TSF (548 acres), the open pit (178 acres), and the haul road (162 acres).

Within the Mine Site, most impacts to wetlands (XX acres) would occur within one of the HUC10 watersheds, named the "Headwaters Koktuli River watershed" (Figure 4.22-1; Table 4.22-1). Less than 10 of impacts to wetlands and waters would occur within the Upper Talarik Creek Watershed (Table 4.22-1). Direct impacts in these watersheds would affect primarily deciduous shrub wetlands on slopes (XX percent and XX percent, respectively) and herbaceous wetlands on slopes (XX percent and XX percent, respectively). Previous disturbance to wetlands in this area is minimal. Facilities have been sited to avoid and minimize wetland impacts and allow efficient reclamation of disturbed areas.

[Note: The above sections will be updated with an updated project footprint.]

Excavation, filling, and clearing of wetlands would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions. Construction-related disturbances may alter wetland modification of groundwater functions (recharge and discharge), and would decrease stormwater and floodwater storage and modification of streamflow functions by decreasing the wetlands' potential to dissipate energy and reduce peak flows. These altered hydrologic functions would extend to the streams connected to or downstream from the affected wetlands. See Section 4.16, Surface Water Hydrology, for a discussion of surface water hydrology impacts.

Construction on or through wetlands would decrease or remove the wetlands' potential to improve water quality by preventing erosion and settling sediments. Sediment barriers and erosion control planning would mitigate the loss of this wetland function. Vegetation clearing with no soil disturbance reduces the wetlands' ability to modify water quality and its contribution to the abundance and diversity of wetland fauna. It also may reduce the export of detritus and contribution to the abundance and diversity of wetland flora functions, depending on the extent of vegetation being cleared.

The Headwaters Koktuli River watershed is estimated to contain approximately 56,000 acres of wetlands and waterbodies (33 percent of the watershed). Approximately 45,000 acres (26 percent of the watershed), are shrub wetlands and 9,000 acres (five percent) are herbaceous wetlands. Forested wetlands (39 acres) and aquatic bed wetlands (132 acres) each cover less than one percent. Mine Site activities would affect 2,460 acres of shrub wetlands and 657 acres of herbaceous wetlands within the Headwaters Koktuli River watershed (Table 4.22-1). This represents approximately five percent and seven percent, respectively, of shrub and herbaceous wetlands in the watershed. No forested wetlands and one acre of aquatic bed wetlands would be affected.

[Note: Information on specifics of unique, rare, or high-value wetlands types will be added in a later version.]

Riverine wetlands are another potentially high-value wetland type because of their numerous functions, especially fish and wildlife habitat functions. A total of 176 acres of riverine HGM class wetlands in the Headwaters Koktuli River watershed would be affected by activities at the Mine Site. The extent of riverine wetlands in the watershed is not known. They account for approximately six percent of the Mine Site mapping area. The watershed contains the North Fork and South Fork Koktuli River and their numerous tributaries. It is expected that riverine wetlands would account for at least six percent of the watershed as a whole, or approximately 10,000 acres. Therefore, the area of impacts from Mine Site activities would represent approximately two percent of all riverine wetlands in the watershed. Less than one acre of riverine HGM class wetlands in the Upper Talarik Creek Watershed would be affected by activities at the Mine Site.

Figure 4.22-1: Mine Site Area Watersheds Wetlands Impacts
[Note: Figure under development]

[Note: Table to be updated with revised project description information.]

Table 4.22-1: Mine Site Wetlands Direct Impacts

NWI Group	HGM[1] Class (Acres/percent)							Impact Area (acres)	Impact Area (%)
	Slope	Riverine	Riverine Channel	Depression	Flats	Lacustrine Fringe	Lacustrine Waters		
Headwaters Koktuli River Watershed									
Deciduous Shrub Wetlands	**2,247 71%**	**131 4%**	0	7 <1%	74 2%	<1	0	2,460	76
Herbaceous Wetlands	**607 19%**	40 1%	<1	3 <1%	6 <1%	<1	0	657	20
Aquatic Bed Wetlands	1 <1%	0	0	0	0	0	0	1	<1
Ponds	11 <1%	4 <1%	0	16 <1%	0	0	0	31	1
Lakes	0	0	0	0	0	0	<1	<1	<1
Perennial Streams	0	0	29 1%	0	0	0	0	29	1
Intermittent Streams	0	0	3 <1%	0	0	0	0	3	<1
Wetland/Water Totals	2,867	176	32	26	80	1	<1	**3,182**	100
Area (%)	90	5	1	1	2	<1	<1		
Uplands	3,658								
Totals	6,840								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									
Upper Talarik Creek Watershed									
Deciduous Shrub Wetlands	**6 67%**	<1	0	0	<1	0	0	6	67
Herbaceous Wetlands	**3 33%**	<1	0	<1	0	0	0	3	33
Aquatic Bed Wetlands	0	0	0	0	0	0	0	0	0
Ponds	0	0	0	<1	0	0	0	<1	<1
Lakes	0	0	0	0	0	0	0	0	0
Perennial Streams	0	0	<1	0	0	0	0	<1	<1
Intermittent Streams	0	0	<1	0	0	0	0	<1	<1
Wetland/Water Totals	9	<1	<1	<1	<1	0	0	**9**	100
Area (%)	100	<1	<1	<1	<1	0	0		
Uplands	25								
Totals	34								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									

[1]HGM = hydrogeomorphic

Reclamation

Pebble Limited Partnership (PLP) has incorporated requirements for mine closure and long-term water management into the design of the project. During the permitting phase, a reclamation plan would be developed that would include reclamation of wetlands where feasible. The discussion below is based on generally accepted wetland reclamation practices for mine sites in Alaska. PLP has also provided some conceptual-level information on reclamation in its application and in subsequent responses to requests for information.

The Alaska Department of Natural Resources (ADNR) approves reclamation plans and associated financial assurances before construction. In its project description for the Department of the Army Application (December 2017), PLP has identified some of the design elements that would facilitate successful reclamation during and after the closure phase:

- Quarried and waste rock would be geochemically tested prior to being used in construction to avoid the potential for contaminated drainage during operations and post-closure.
- Topsoil and overburden would be salvaged during construction for use as growth medium during reclamation.
- TSF embankment slopes would be designed to provide long-term stability and facilitate the placement of growth medium.
- The overall project footprint would be minimized to facilitate physical closure and post-closure water management.

[Note: This section will be updated with information from RFI 024.]

Material sites constructed in valley bottoms or lowland sites are candidates to be reclaimed to create new ponds with emergent wetlands where sufficient water quality and hydrology are available. Final contouring around created ponds could focus on providing habitat at the water's edge and a complex interspersion between wetland and upland vegetation. Moderate to steeply sloping wetland or upland mosaics with wetland inclusions would be less feasible to restore to wetlands because of the marginal hydrology, and some fills may not be removed in these areas. Marginal wetland hydrology would be expected in areas where excavations and road cuts through colluvium and rock have reduced overland sheet flow.

Shrub wetland successional processes, generally initiated by natural disturbances such as wildland fires, gradually reestablish typical vegetation and eventually hydrologic characteristics. When construction disturbs wetlands, successional processes may be prolonged or may not occur. Construction disturbances differ from natural disturbances in that the organic mat and organic soil horizons are often removed completely, which removes seedbeds, and reduces surface and subsurface water storage capacity. The timing and extent of recovery likely depend on the intensity, extent, and duration of the disturbance. The time required for wetlands to return to pre-disturbance soil moisture and original vegetation cover has not been well documented in western Alaska.

Development of self-sustaining wetland plant communities on previously disturbed Alaska wetlands may occur within 10 to 30 years, but may be slowed in gravelly or sandy soils, and by years with failed seedling establishment or seed production. Revegetation success may be enhanced by conducting careful planning and management; minimizing disturbance; segregating and protecting materials to be used during reclamation; using the appropriate seed mixture and seeding rates; and monitoring for erosion and revegetation success.

Reclamation of wetland conditions may be complicated in areas where less permeable layers have been breached or removed. This would alter surface hydrology, causing previous wetland areas to drain. In these situations, restored wetlands are likely to differ in type and functional capacity from the original wetlands for decades to centuries.

Surface water resources available to wetlands would continue to be altered in distribution and abundance with an estimated return to within XX percent of predevelopment streamflows at the downstream end of the mine development (see Section 4.16, Surface Water Hydrology). These changes in surface water distribution and abundance could cause some wetlands to dry up while others would be inundated or become wetter.

The pit lake would continue to fill for a period of several decades post-closure. Once the water level reaches elevation 890 feet, water would be pumped from the pit. This elevation is at least 50 feet below the elevation at which groundwater flow would be directed outward from the open pit. As a result, a new equilibrium groundwater level would become established around the pit. Wetlands and streams above the pit lake level would potentially lose groundwater to the cone of depression created by the pit lake. This may result in long-term wetland and streamflow effects. Groundwater modeling would be used to assess potential wetland and stream dewatering, and to identify those wetlands and functions that are likely to be affected (see Section 4.17, Groundwater Hydrology, for details).

[Note: The above sections will be updated with an updated project footprint.]

4.22.2.2 Mine Site Indirect Impacts

[Note: Information on this topic to be added at a later time].

Fugitive Dust

[Note: Information on this topic to be added at a later time].

Dewatering

[Note: Information on this topic to be added at a later time].

4.22.2.3 Amakdedori Port Direct Impacts

[Note: This section to be updated with revised project description information.]

Construction of Amakdedori Port would directly affect less than one acre of intertidal waters and 109 acres of subtidal waters in the Amakdedori Creek-Frontal Kamishak Bay watershed and 271 acres of subtidal waters in the Cook Inlet watershed (Table 4.22-2). The port terminal and associated facilities would be sited and designed to avoid most wetlands. Previous disturbance to wetlands or waterbodies in this area is minimal.

The Amakdedori Port facilities would be removed during closure, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies. Disturbed areas would be recontoured, graded, ripped, and scarified. Topsoil and growth media would be placed as needed, and surfaces would be seeded for revegetation.

Table 4.22-2: Amakdedori Port Wetlands Direct Impacts

NWI Group	Impact Area (acres)	Impact Area (%)
Amakdedori Creek–Frontal Kamishak Bay Watershed		
Marine Subtidal	109	99
Marine Intertidal	1	1
Wetland/Water Totals	110	100
Uplands	194	–
Total Area	305	–
Cook Inlet Watershed		
Marine Subtidal	271	100
Total Area	271	–

[Note: Table to be updated with revised project description information.]

4.22.2.4 Amakdedori Port Indirect Impacts

Fugitive Dust

[Note: Information on this topic to be added at a later time].

Dewatering

[Note: Information on this topic to be added at a later time].

4.22.2.5 Transportation Corridor and Natural Gas Pipeline Corridor Direct Impacts

[Note: This section to be updated with revised project description information. Temporary versus permanent impacts will be addressed at that time, and a table with direct temporary impacts for the Natural Gas Pipeline Corridor will be included.]

Locations West of Cook Inlet

Construction of the Transportation and Natural Gas Pipeline corridors from Amakdedori Port to the Mine Site would directly and permanently affect XX acres of wetlands (Table 4.22-3). The south access road between the port and the south ferry terminal at Iliamna Lake would affect XX acres. The mine access road from the north ferry terminal to the mine site would affect ## acres of wetlands and waterbodies. The remaining XX acres of impacts would be from the Iliamna and Kokhanok Airport spur roads, material sites, and ferry landings.

Impacts would be permanent because the road would remain to facilitate long-term post-closure water treatment and monitoring. Previous disturbance to wetlands in this area is minimal. The corridor has been sited to avoid and minimize wetland impacts and allow for efficient reclamation of disturbed areas.

A total of XX miles of streams would be directly affected by construction, including XX miles of perennial streams and XX miles of intermittent streams (Table 4.22-3). The larger streams with a width at ordinary high water (OHW) of 16 feet or greater would be bridged. Bridge locations are shown in Figure 4.22-2. Site-specific designs have been developed for bridges. Smaller stream crossings would use a series of standardized, conceptual culvert design categories based on stream width and fish presence. See Section 4.16, Surface Water Hydrology, for a discussion of surface water hydrology impacts.

Activities in the Transportation and Natural Gas Pipeline corridors would affect wetlands in five HUC10 watersheds. The highest number of acres impacted (XX acres) would occur in the Upper Talarik Creek watershed (Figure 4.22-2; Table 4.22-3). Direct impacts in this watershed would affect primarily deciduous shrub wetlands on slopes (XX percent) and flats (XX percent), and along streams (XX percent).

The Upper Talarik Creek watershed is estimated to contain approximately 34,000 acres of wetlands and waterbodies (39 percent of the watershed). Approximately 31,000 acres (35 percent of the watershed) are shrub wetlands, and 1,200 acres (one percent) are herbaceous wetlands. Forested wetlands (636 acres) and aquatic bed wetlands (eight acres) each cover less than 1 percent. Activities in the Transportation and Natural Gas Pipeline corridors and in a small portion of the Mine Site would affect XX acres of shrub wetlands and XX acres of herbaceous wetlands in the Upper Talarik Creek watershed, which is estimated to be less than one percent of shrub and herbaceous wetlands in the watershed. No forested or aquatic bed wetlands would be affected.

Based on vegetation and wetland mapping for the project, five acres of bog vegetation would be affected by activities in the Transportation and Natural Gas Pipeline corridors in the Upper Talarik Creek watershed. The extent of bog vegetation in the watershed is not known.

A total of XX acres of riverine wetlands would be affected by activities in the Transportation and Natural Gas Pipeline corridors in the Upper Talarik Creek watershed (Table 4.22-3). The extent of riverine wetlands in the watershed is not known. They account for approximately four percent of the Transportation and Natural Gas Pipeline corridor mapping areas. Riverine wetlands are estimated to account for approximately four percent of the watershed as a whole, or 3,500 acres. The corridor impacts, therefore, would represent less than two percent of all riverine wetlands in the watershed.

Wetland and waterbody impacts in the other four watersheds would be relatively low from a watershed perspective. The Iliamna Lake watershed, excluding the lake itself, has an estimated 180,000 acres of wetlands and waterbodies (33 percent of the watershed). The project would result in direct impacts on XX acres of slope wetlands and one acre of riverine wetlands (Table 4.22-3). The Newhalen River watershed has an estimated 35,000 acres of wetlands and waterbodies (29 percent of the watershed); one acre of slope wetlands would be directly affected. The Gibraltar Lake watershed has an estimated 34,000 acres of wetlands and waterbodies (41 percent of the watershed); nine acres of slope wetlands would be directly affected. The Amakdedori Creek–Frontal Kamishak Bay watershed has an estimated 77,000 acres of wetlands and waterbodies (44 percent of the watershed); 15 acres of slope wetlands and one acre of riverine channel would be directly affected (Table 4.22-3). The Transportation Corridor does enter the Paint River watershed for a very short distance, but no wetland or waterbody impacts are anticipated.

[Note: Table to be updated with revised project description information.]

Table 4.22-3: Transportation Corridor and Natural Gas Pipeline Corridor (West of Cook Inlet) Wetlands Direct Impacts

NWI Group	HGM Class (Acres/percent)							Impact Area (Acres)	Impact Area (%)
	Slope	Riverine	Riverine Channel	Depression	Flats	Lacustrine Fringe	Lacustrine Waters		
Upper Talarik Creek Watershed									
Deciduous Shrub Wetlands	**34** **64%**	**6** **11%**	–	–	**5** **9%**	–	–	46	87
Herbaceous Wetlands	**4** **8%**	1	–	–	2	–	–	6	11
Wetland/ Water Totals	38	7	–	–	7	–	–	**53**	100
Area (%)	72	13	<1	<1	13	0	0		
Uplands	324								
Totals	377								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									
Newhalen River Watershed									
Deciduous Shrub Wetlands	1	–	–	–	–	–	–	1	100
Wetland/Water Totals	1	<1	<1	<1	0	0	0	**1**	100
Area (%)	100	<1	<1	<1	0	0	0		
Uplands	50								
Totals	52								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									
Iliamna Lake Watershed									
Deciduous Shrub Wetlands	**9** **50%**	–	–	–	–	–	–	10	56
Evergreen Shrub Wetlands	1	–	–	–	–	–	–	1	6
Herbaceous Wetlands	**5** **28%**	1	–	–	–	–	–	6	33
Ponds	1	–	–	–	–	–	–	1	6
Wetland/Water Totals	17	1	<1	<1	0	0	0	**18**	100
Area (%)	94	6	<1	<1	0	0	0		
Uplands	326								
Totals	**344**								

Table 4.22-3: Transportation Corridor and Natural Gas Pipeline Corridor (West of Cook Inlet) Wetlands Direct Impacts

NWI Group	HGM Class (Acres/percent)							Impact Area (Acres)	Impact Area (%)
	Slope	Riverine	Riverine Channel	Depression	Flats	Lacustrine Fringe	Lacustrine Waters		
Gibraltar Lake Watershed									
Deciduous Shrub Wetlands	**3** **33%**	–	–	–	–	–	–	3	33
Evergreen Shrub Wetlands	**2** **22%**	–	–	–	–	–	–	2	22
Herbaceous Wetlands	**3** **33%**	–	–	–	–	–	–	3	33
Ponds	1	–	–	–	–	–	–	1	11
Wetland/Waters Totals	9	0	<1	0	0	0	<1	**9**	100
Area (%)	100	0	<1	0	0	0	<1		
Uplands	132								
Totals	**142**								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									
Amakdedori Creek–Frontal Kamishak Bay Watershed									
Deciduous Shrub Wetlands	**6** **38%**	–	–	–	–	–	–	6	38
Herbaceous Wetlands	**5** **31%**	–	–	–	–	–	–	5	31
Ponds	**3** **19%**	–	–	–	–	–	–	3	19
Streams	–	–	1	–	–	–	–	1	6
Wetland/Waters Totals	15	0	1	<1	0	0	<1	**16**	100
Area (%)	94	0	6	<1	0	0	<1		
Uplands	166								
Totals	182								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									

Figure 4.22-2: Upper Talarik Creek Watershed Impacts

[Note: Figure under development]

Locations East of Cook Inlet

[Note: The following section to be updated with revised project description information.]

Activities in the Natural Gas Pipeline Corridor on the Kenai Peninsula would affect wetlands and waterbodies in the Stariski Creek–Frontal Cook Inlet watershed (Figure 4.22-3). Direct impacts on this watershed would affect primarily shrub wetlands.

The pipeline would cross approximately 94 miles of Cook Inlet, between Anchor Point and Amakdedori Port. Horizontal directional drilling would be used to install pipe segments from the compressor station out into waters that are deep enough to avoid navigation hazards. From this point, the pipe would be installed in a trench out to a water depth of 200 feet, and then laid on the sea floor. Direct temporary impacts on approximately 340 acres of marine subtidal waters and less than one acre of intertidal waters would occur (Table 4.22-4). The compressor station at Anchor Point would be located in an area that would avoid wetland impacts.

Reclamation

The road system would be retained as long as required for the transport of bulk supplies needed for long-term post-closure water treatment and monitoring. Once no longer needed, the road system would be reclaimed. Disturbed areas would be recontoured, graded, ripped, and scarified. Topsoil and growth media would be placed as needed, and surfaces would be seeded for revegetation. The Iliamna Lake ferry facilities would be removed during closure. Once it is no longer required to provide energy to the Mine Site, the natural gas pipeline would be pigged and cleaned before being abandoned in place. Surface facilities associated with the pipeline would be removed and reclaimed.

During closure and post-closure, wetlands would be reestablished wherever practicable. The geographic extent of direct and indirect effects would affect five HUC10 watersheds, but the majority of impacts (54 percent) would occur in the Upper Talarik Creek watershed, in the Bristol Bay basin. Most impacts throughout all watersheds would be on shrub (59 percent) and herbaceous (18 percent) wetlands on slopes, which are common throughout the region. There would be some impacts on riverine wetlands (eight acres) that are important for fish habitat, although this represents a relatively small portion of riverine wetlands across all watersheds.

[Note: Table to be updated with revised project description information.]

Table 4.22-4: Natural Gas Pipeline Corridor (East of Cook Inlet) Wetlands Direct Impacts

NWI Group	Impact Area (acres)	Impact Area (%)
Amakdedori Creek–Frontal Kamishak Bay Watershed		
Marine Subtidal	3	100
Cook Inlet Watershed		
Marine Subtidal	334	100
Stariski Creek–Frontal Cook Inlet Watershed		
Forested Wetlands	<1	20
Shrub Wetlands	1	20
Herbaceous Wetlands	<1	–
Perennial Streams	<1	–
Marine Subtidal	3	60

Marine Intertidal	<1	–
Wetland/Water Totals	5	100
Uplands	37	–
Total Area	380	–

EPA-0135-0004595

Figure 4.22-3: Stariski Creek–Frontal Cook Inlet Watershed Impacts

[Note: Figure under development].

4.22.2.6 Transportation Corridor and Natural Gas Pipeline Corridor Indirect Impacts

Fugitive Dust

[Note: Information on this topic to be added at a later time].

Dewatering

[Note: Information on this topic to be added at a later time].

4.22.2.7 Cumulative Effects

[Note: This section will be updated at a later time.]

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Note to Reviewers

This section is an early stage preliminary draft, and has been prepared prior to the completion of scoping for the purpose of setting analytical direction and facilitating the project schedule for completing the EIS.

As an initial draft, it is incomplete in many ways, and contains numerous placeholders to be addressed as more information becomes available. The Scoping Comment Period has not closed, Alternatives to the Proposed Action have not been formally identified, information needed to complete the analysis is not yet fully available and in the process of being requested from the applicant, and the approach for topics such as spills/dam failures, traditional knowledge and cumulative effects has not been settled. In addition, supporting analysis and logic for determination of potential environmental consequences have not been fully developed. This draft is intended to frame the eventual section, and in doing so, allow USACE to see the intended topics and content for the eventual completed sections. Notes are included in many sections to identify where the analysis is incomplete.

4.26 VEGETATION

Potential direct and indirect effects impacting vegetation include:

- Direct impacts from vegetation removal
- Direct impacts from removal of rare and sensitive plants; indirect impacts from habitat disturbance
- Indirect impacts from invasive species introduction or spread
- Indirect impacts from fugitive dust
- Indirect impacts from dewatering.

Impact assessments were considered, analyzed, and determined from the perspective of overall regional Alaskan vegetation affected. To contextualize project impacts, the analysis for vegetation makes use of publically available environmental data for the environmental impact statement (EIS) analysis area (the nine Hydrologic Unit Code [HUC] 10 watersheds that could potentially be directly or indirectly impacted).

The magnitude of impacts to vegetation were assessed in terms of disturbance to above-ground vegetation and soil disturbance. Vegetation would be removed above the surface, or would also involve soil disturbance. Some areas of vegetation removal and soil disturbance would be reclaimed, and some would not. The duration of impacts would be temporary, meaning removal and/or disturbance would occur during the construction phase; or permanent, meaning removal and/or disturbance would occur or remain after the construction phase, through the operations and into the closure and post-closure phase. The extent of impacts would be limited to areas of the project area in which vegetation would be removed/disturbed, or would affect vegetation outside of the project area, within one or more HUC 10 watersheds.

4.26.1 No Action Alternative

Under the No Action alternative, the project would not be constructed, and would not have any new effects on vegetation.

4.26.2 Action Alternative 1 – Applicant's Proposed Alternative

4.26.2.1 Mine Site Direct Impacts

Vegetation Removal

Construction and operations of the Mine Site would require clearing, grading, and removal of vegetation in areas where the Mine Pit, Tailings Storage Facility (TSF), overburden stockpiles, material sites, water management ponds, milling and processing facilities, access roads, and supporting infrastructure would be located. Shrubs, trees, understory vegetation, roots, and other obstructions such as large rocks and stumps would be cleared from construction work areas. Vegetation removal can cause numerous changes in the surrounding environment, such as:

- Increased rate of soil erosion from wind or water
- Changes in water drainage patterns (increased runoff volumes)
- Sediment deposition in downslope areas
- Changes in adjacent vegetation type composition
- Changes in wildlife habitat
- Introduction or spread of invasive species.

Acres of direct impacts to vegetation were calculated by overlaying the project footprint over vegetation types in ArcGIS, and calculating the area impacted for each vegetation type in the project component mapping areas.

Table 4.26-1 lists the acreage and percent of the grouped vegetation types in the Mine Site mapping area that would be directly affected by clearing, grading, and removal activities during construction and operation of the Mine Site. The acreage and percent of each vegetation type affected in the relevant HUC 10 watersheds that the Mine Site mapping area falls within are also included to assess the magnitude and extent of impacts from the perspective of overall regional Alaskan vegetation affected. Figure 4.26-1 shows grouped vegetation type locations in the Mine Site project footprint.

In some locations, removal would be permanent (such as the mine pit that would become a pit lake, and bulk TSF that would become a new landform). In all other areas, removal would be temporary. In temporary disturbance areas, vegetation would be reestablished by reclamation, which would begin immediately after construction, and continue through to closure. In some areas, natural revegetation would be expected to occur. [Note: Specific areas will be included with updated project design.] All road material sites would be stabilized and progressively reclaimed, but would remain active to support ongoing road maintenance requirements through operation. Mine laydown areas would be retained for use through operations. All construction roads would continue to serve as site access roads.

Disturbed areas that are reclaimed are expected to continue vegetation succession over time, which would improve soil and habitat quality for wildlife. Successional species would likely include those found outside of the Mine Site as seeds from the surrounding areas are dispersed and establish on reclaimed sites. Vegetation reestablishment time of cleared or graded areas is variable. Trees and shrubs are expected to begin to re-establish almost immediately after construction and reclamation. Alders (*Alnus* spp.), willows (*Salix* spp.), and birch (*Betula* spp.) are generally the first trees and shrubs to re-establish. Reclamation details are provided in Section 3.26, Wetlands/Special Aquatic Sites.

[Note: Section and table to be completed with updated project footprint information; reclamation details will be provided in Section 3.22, Wetlands/Special Aquatic Sites, after further development of a reclamation and closure plan and from RFI 24.]

Table 4.26-1: Mine Site Vegetation Removal Impacts

Grouped Vegetation Type	Impacts in Mapping Area (Acres/Percent)	Impacts in the Analysis Area[1]	
		Headwaters Koktuli River (Acres/Percent)	Upper Talarik Creek Watershed (Acres/Percent)
Open/Closed Forest			
Open Tall Shrub			
Closed Tall Shrub			
Open Low Shrub			
Closed Low Shrub			
Dwarf Shrub			
Dry to Moist Herbaceous			
Wet Herbaceous			
Open Water			
Other			
Total			

[1] Represents the total area of the grouped vegetation type in each of the HUC 10 watersheds that comprise the Mine Site mapping area, and the percent of the vegetation type impacted per watershed.

Source: Boggs et al. 201

Figure 4.26-1: Mine Site Vegetation Removal

[Note: Figure to be added later.]

Rare or Sensitive Species

There are no occurrences of rare or sensitive plant species in the Mine Site.

4.26.2.2 Mine Site Indirect Impacts

Invasive Species

[Note: Additional details on Mine Site invasive species to be provided at a later time.]

Fugitive Dust

Fugitive dust emissions are a by-product of construction and operations activities. Dust would be caused by vehicle travel on the mine roads and other unpaved surfaces in the mine, as well as by mining activities at the pit. This dust has the potential to collect on vegetation in the vicinity of the dust sources. Windblown dust could affect vegetation well beyond the source, but the effect diminishes with distance and is affected by prevailing winds and topography. The deposition of dust has been analyzed in Section 4.14, Soils, with information on impacts to wetlands included in Section 4.22, Wetlands/Special Aquatic Sites.

The intensity of the impacts would be expected to vary depending on proximity of vegetation to the source of the dust. Dust may cause variable physiological changes to vegetation depending on exposure length or level. The duration of the effects would be both seasonal, when dust is washed off during winter months (or when deciduous species lose leaves), and throughout construction and operations. In some cases, impacts may last past closure where physiological changes may occur within plants, or where vegetation community changes may take place. The extent would be in areas adjacent to roads with vehicle traffic or in unpaved surface areas, and in the dust emissions areas, with highest concentrations of dust closest to the source.

Dewatering

Groundwater lowering may reduce water availability to plant species. Response of terrestrial vegetation to reduced water availability depends on the water requirements of individual plant species, root depths, and tolerances. Plants with shallow root systems that require a fairly constant supply of water would be impacted to a greater extent than drought-tolerant or deep-rooted species. Impacts on vegetation from reduction in water availability may include stunted growth, greater susceptibility to disease (NCDENR 2009), and succession of more drought-tolerant species. Impacts would depend on the actual timing and location of the groundwater lowering and the tolerance of the vegetation types. Impacts on groundwater are discussed in Section 4.17, Groundwater Hydrology. Impacts on wetland vegetation are presented in Section 4.22, Wetlands/Special Aquatic Sites.

In areas where vegetation is removed and is no longer present to intercept rainfall and reduce runoff, indirect effects could result from erosion of the exposed soil and sedimentation. Areas without well-established vegetation may also be susceptible to invasion by invasive species. Drainage and erosion control measures, both temporary and permanent, would be implemented at the Mine Site, and reclaimed areas would be reseeded for vegetation to prevent erosion of soils and potential invasion by weeds. Impacts to soil are addressed in Section 4.14, Soils.

4.26.2.3 Amakdedori Port Direct Impacts

Vegetation Removal

Construction and operations of the Amakdedori Port would require clearing, grading, and removal of vegetation in areas along the access road, dredge stockpile area, and where the shore-based facilities would be located, such as facilities for receipt and storage of containers, fuel storage and transfer, power generation and distribution, maintenance, and employee accommodations.

All temporary construction facilities would be removed after construction, and the sites would be reclaimed, unless being used for permanent facilities. Temporary facilities associated with the Amakdedori Port include the construction camp; however, this facility would be located in an area that would be used for port operations, and would not involve a separate footprint.

The Amakdedori Port facilities would be removed and reclaimed after closure activities are completed, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies.

Table 4.26-2 lists the acreage and percent of the grouped vegetation types in the Amakdedori Port mapping area that would be directly affected by clearing, grading, and removal activities during construction and operation of the Mine Site. Figure 4.26-2 shows grouped vegetation type locations in the Amakdedori Port component.

[Note: Section and table to be completed with updated project footprint information.]

Table 4.26-2: Amakdedori Port Vegetation Removal Impacts

Grouped Vegetation Type	Impacts in Mapping Area (Acres/Percent)	Impacts in the Analysis Area[1]	
		Headwaters Koktuli River (Acres/Percent)	Upper Talarik Creek Watershed (Acres/Percent)
Open/Closed Forest			
Open Tall Shrub			
Closed Tall Shrub			
Open Low Shrub			
Closed Low Shrub			
Dwarf Shrub			
Dry to Moist Herbaceous			
Wet Herbaceous			
Open Water			
Other			
Total			

[1]Represents the total area of the grouped vegetation type in each of the HUC 10 watersheds that comprise the Mine Site mapping area, and the percent of the vegetation type impacted per watershed.

Source: Boggs et al. 2016

Figure 4.26-2: Vegetation Types in Amakdedori Port

[Note: Figure to be added later.]

Rare or Sensitive Species

There are no occurrences of rare or sensitive plant species at the Amakdedori Port, or within a 1-mile radius.

4.26.2.4 Amakdedori Port Indirect Impacts

Invasive Species, Fugitive Dust, and Changes in Water Availability

The indirect impacts, including increased risk of invasive species introduction and spread, fugitive dust during construction and operations, and changes in water availability, would be similar to those described at the Mine Site.

4.26.2.5 Transportation and Natural Gas Pipeline Corridors Direct Impacts

Vegetation Removal

Construction and operations of the Transportation and Natural Gas Pipeline Corridor components would require clearing, grading, and removal of vegetation in areas where the roads, ferry terminals, laydown areas, material sites, and buried onshore pipeline would be located. During operations, periodic brushing of the revegetated pipeline corridor would occur.

Table 4.26-3 lists the acreage and percent of the grouped vegetation types in the Transportation and Natural Gas Pipeline Corridor that would be directly affected by clearing, grading, and removal activities during construction and operation of the Mine Site. Figures 4.26-3 and 4.26-4 show grouped vegetation type locations in the Transportation and Natural Gas Pipeline Corridor component project footprints.

The impacts associated with the natural gas pipeline would be temporary, because reclamation would occur shortly after installation. All temporary construction facilities would be removed after construction, and the sites, unless being used for permanent facilities, would be reclaimed. Temporary facilities associated with the Transportation/Natural Gas Pipeline Corridor on the western side of Cook Inlet include the camps established at the ferry landings.

The road system would be retained as long as required for the transport of bulk supplies needed for long-term post-closure water treatment and monitoring. The Iliamna Lake ferry facilities would be removed, and all closure-related supplies would be transported across the lake using a summer barging operation.

Rare or Sensitive Species

Two occurrences of one rare plant, Selkirk's violet (*Viola selkirkii*), were documented approximately 1.2 miles away from the road corridor (see rare and sensitive plant location map in Section 3.26, Vegetation). Impacts to this plant would be limited to potential indirect impacts if habitat were impacted by vegetation removal, or by indirect impacts such as fugitive dust presence.

[Note: Section and table to be completed with updated project footprint information.]

Table 4.26-3: Transportation and Natural Gas Pipeline Corridors Removal Impacts

Grouped Vegetation Type	Impacts in Mapping Area (Acres/Percent)	Impacts in the Analysis Area[1]	
		Headwaters Koktuli River (Acres/Percent)	Upper Talarik Creek Watershed (Acres/Percent)
Open/Closed Forest			
Open Tall Shrub			
Closed Tall Shrub			
Open Low Shrub			
Closed Low Shrub			
Dwarf Shrub			
Dry to Moist Herbaceous			
Wet Herbaceous			
Open Water			
Other			
Total			

[1]Represents the total area of the grouped vegetation type in each of the HUC 10 watersheds that comprise the Mine Site mapping area, and the percent of the vegetation type impacted per watershed.

Source: Boggs et al. 2016

4.26.2.6 Transportation and Natural Gas Pipeline Corridors Indirect Impacts

Invasive Species, Fugitive Dust, and Changes in Water Availability

Indirect impacts would be similar to those described at the Mine Site. Because the roads and pipeline cross several watersheds, these impacts could affect a wider area compared to the Mine Site. Dust impacts would occur within a narrow corridor on either side of the roadways. The risk of invasive species being introduced or spread is higher for this component. The road and pipeline corridor could also cause wide-ranging changes in water availability due to the elevation of the roadway and structures necessary for water flow control adjacent to the roadways.

Figure 4.26-3: Vegetation Types in the Transportation Corridor

[Note: Figure to be added later.]

Figure 4.26-4: Vegetation Types in the Natural Gas Pipeline Corridor

[Note: Figure to be added later.]

4.26.2.7 Cumulative Effects

[Note: This section will be updated at a later time.]

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Message

From: McGrath, Patricia [mcgrath.patricia@epa.gov]
Sent: 8/23/2018 10:52:14 PM
To: Maley, Timothy [maley.timothy@epa.gov]; Vaughan, Molly [Vaughan.Molly@epa.gov]; Douglas, Mark [douglas.mark@epa.gov]; Eckley, Chris [Eckley.Chris@epa.gov]; Godsey, Cindi [Godsey.Cindi@epa.gov]; Pepple, Karl [Pepple.Karl@epa.gov]; McAlpine, Jerrold [McAlpine.Jay@epa.gov]; Palomaki, Ashley [Palomaki.Ashley@epa.gov]; Hough, Palmer [Hough.Palmer@epa.gov]; Thiesing, Mary [Thiesing.Mary@epa.gov]; Schofield, Kate [Schofield.Kate@epa.gov]
Subject: FW: no response requested
Attachments: 60-Day Pebble Priority Schedule 8.6.2018.xlsx

Pebble EIS reviewers-
As discussed during today's team meeting, attached is a 60-day schedule that shows upcoming EIS development activities and areas where cooperating agencies (CAs) will be involved. I have not received a response back from the Corps on whether we will be able to review revised sections of chapters 3 and 4 before the technical discussions that are shown on this schedule.
Patty

-----Original Message-----
From: POA Special Projects [mailto:poaspecialprojects@usace.army.mil]
Sent: Wednesday, August 8, 2018 4:40 PM
To: bobl@jadenorth.com; Brooke Merrell <brooke_merrell@nps.gov>; Curyung Tribal <courtenay@curyungtribe.com>; 'cvaughn@achp.gov' <cvaughn@achp.gov>; Daugherty, Linda (PHMSA) <linda.daugherty@dot.gov>; David Seris (David.M.Seris@uscg.mil) <David.M.Seris@uscg.mil>; Douglass Cooper <douglass_cooper@fws.gov>; Hassell, David (PHMSA) <david.hassell@dot.gov>; Joan Kluwe <joan_kluwe@nps.gov>; John Eddins <jeddins@achp.gov>; Kevin Pendegast <kevin.pendergast@bsee.gov>; 'mary_colligan@fws.gov' <mary_colligan@fws.gov>; McCafferty, Katherine A CIV USARMY CEPOA (US) <Katherine.A.McCafferty2@usace.army.mil>; McCall, John <john.mccall@bsee.gov>; McGrath, Patricia <mcgrath.patricia@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>; Moselle, Kyle W (DNR) <kyle.moselle@alaska.gov>; manager@lakeandpen.com; POA Special Projects <poaspecialprojects@usace.army.mil>; nondaltontribe@yahoo.com; Wesley Furlong <wfurlong@narf.org>
Cc: POA Special Projects <poaspecialprojects@usace.army.mil>
Subject: no response requested

All,

Attached is a 60-day priority schedule highlighting major milestones. There is a column for “who's involved” and more detail on when activities take place or are due.

VR

Shane McCoy
Program Manager

Activity	Who's Involved
Scoping Report	
Receive draft scoping report comments from CAs and USACE	CAs, USACE
Incorporate CA and USACE comments to prepare the final scopoing report	AECOM
Deliver Final Scoping Report to USACE	AECOM
USACE reviews final scoping report	USACE
Integrate any final USACE comments	AECOM
Deliver final scoping report to USACE	AECOM
Draft EIS Chapter 3	
Revise Chapter 3	AECOM
Incorporate CA comments (both scoping comments and predraft Chapter 3 comments)	AECOM
Incorporate alternatives	AECOM
Technical discussions on sections	CAs, AECOM (USACE as needed)
Draft EIS Chapter 4	
Revise Chapter 4	AECOM
Receive predraft Chapter 4 comments from CAs and USACE	AECOM
Early technical meetings as needed between CAs and AECOM staff	AECOM, CAs, USACE
Incorporate predraft Chapter 4 comments	AECOM
Incorporate alternatives	AECOM
Technical discussions on sections	CAs, AECOM (USACE as needed)
Draft EIS Chapter 2 - Alternatives	
Develop a wide range of alternatives; develop and apply screening criteria	AECOM
Deliver screened alternatives memo	AECOM
Review screened alternatives; prepare discussion for alternatives meeting	CAs, USACE
Alternatives meeting (half day at AECOM)	AECOM, CAs, USACE
Develop memo with list of dismissed alternatives	AECOM
Deliver dismissed alternatives memo	AECOM
Develop final alternatives list	AECOM
Deliver final alternatives memo	AECOM
Technical discussions on chapter	CAs, AECOM (USACE as needed)
Prepare Draft EIS Chapter 2	AECOM
Final Data Gap Assessment Report	
Review and update PDGA reports	AECOM
Prepare final DGA report	AECOM
Deliver Final DGA Report to USACE	AECOM

Time Period or Due Date	Deliverable or Product
8/8	
8/9 to 8/17	
8/17	
8/20 to 8/24	
8/27 to 8/31	
8/31	Final Scoping Report to USACE (PDF)
Now to 8/31	
7/5 to 8/31	
9/21 to 10/31	
10/1 to 11/15	
now to 10/31	
8/31	
7/30 to 9/30	
8/31 to 10/31	
9/21 to 10/31	
10/1 to 11/15	
now to 8/13	
8/14	Memo to USACE (Word)
8/22	
8/23 to 9/5	
9/5	Memo to USACE (Word)
8/23 to 9/19	
9/21	Memo to USACE (PDF)
9/21 to 11/15	
9/24 to 10/31	
8/1-8/31	
9/10-9/11	
9/12	Final DGA Report to USACE (PDF)

Notes
Underway
Will be posted to website and distributed to CAs
EPA meeting 7/30 on physical sciences, possible SoA meetings week of 8/22
Underway
Will be distributed to CAs
Will be distributed to CAs
Will be distributed to CAs
Will be posted to website and distributed to CAs

Message

From: Hough, Palmer [Hough.Palmer@epa.gov]
Sent: 11/27/2018 9:58:11 PM
To: Douglas, Mark [douglas.mark@epa.gov]
Subject: FW: Please Review - Pebble Wetlands Sections
Attachments: Comment spreadsheet blank.docx

Mark - let me know when you have a moment to catch up on Pebble EIS stuff. -Palmer

-----Original Message-----
From: Vaughan, Molly
Sent: Monday, November 26, 2018 2:31 PM
To: Douglas, Mark <douglas.mark@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>
Cc: McGrath, Patricia <mcgrath.patricia@epa.gov>
Subject: Please Review - Pebble Wetlands Sections

Hi Mark and Palmer,
We have received the draft wetlands sections for the Pebble EIS for review, and I have loaded the text and associated figures into the Sharepoint folders. A comment deadline has not yet been provided by the Corps, but I am expecting it to be similar to the new deadline for the other chapters. So, at this point assume that the internal deadline will be somewhere the week of Dec. 10. I will confirm a specific deadline once we hear back from the Corps. As usual, please use the attached comment table for your comments.
Thank you,
Molly

-----Original Message-----
From: POA Special Projects <poaspecialprojects@usace.army.mil>
Sent: Friday, November 23, 2018 11:37 AM
To: bobl@jadenorth.com; Brooke Merrell <brooke_merrell@nps.gov>; Curyung Tribal <courtenay@curyungtribe.com>; Daugherty, Linda (PHMSA) <linda.daugherty@dot.gov>; David Seris (David.M.Seris@uscg.mil) <David.M.Seris@uscg.mil>; Douglass Cooper <douglass_cooper@fws.gov>; Hassell, David (PHMSA) <david.hassell@dot.gov>; J. Loichinger <jloichinger@achp.gov>; Joan Kluwe <joan_kluwe@nps.gov>; John Eddins <jeddins@achp.gov>; Kevin Pendegast <kevin.pendergast@bsee.gov>; 'mary_colligan@fws.gov' <mary_colligan@fws.gov>; McCafferty, Katherine A CIV USARMY CEPOA (US) <Katherine.A.McCafferty2@usace.army.mil>; McCall, John <john.mccall@bsee.gov>; McGrath, Patricia <mcgrath.patricia@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>; Moselle, Kyle W (DNR) <kyle.moselle@alaska.gov>; manager@lakeandpen.com; POA Special Projects <poaspecialprojects@usace.army.mil>; nondaltontribe@yahoo.com; Wesley Furlong <wfurlong@narf.org>
Cc: Craig, Bill <bill.m.craig@aecom.com>; Bella, Elizabeth <elizabeth.bella@aecom.com>
Subject: 3.22 and 4.22 with figures for review (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Good Morning,

Attached are the review drafts for Sec3.22 and Sec4.22, Wetlands. There are no technical appendices with these sections.

Sec 3.22 has one standalone PDF figure (attached) and 7 embedded figures. Sec 4.22 has three standalone PDF figures (attached).

Cooperating agencies with special expertise on this section are USACE and EPA. Suspense date for comments will be provided on Monday.

v/r,

Katie McCafferty
Project Manager
Direct: 907-753-2692

U.S. Army Corps of Engineers-Alaska District Regulatory Division P.O. Box 6898 JBER, AK 99506 main office line: 907-753-2712

CLASSIFICATION: UNCLASSIFIED

Message

From: Vaughan, Molly [Vaughan.Molly@epa.gov]
Sent: 11/21/2018 9:18:30 PM
To: Douglas, Mark [douglas.mark@epa.gov]; McGrath, Patricia [mcgrath.patricia@epa.gov]
Subject: RE: Pebble EIS wetlands sections

I can be available Wednesday if the meeting is in the morning, and also have availability the week of the 10th. I do think that including Palmer would be beneficial.
--Molly

From: Douglas, Mark
Sent: Wednesday, November 21, 2018 12:11 PM
To: McGrath, Patricia <mcgrath.patricia@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>
Subject: RE: Pebble EIS wetlands sections

Patty and Molly,

Personal Matters / Ex. 6 Would either Wednesday or sometime during the week of the 10th work?

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

From: McGrath, Patricia
Sent: Wednesday, November 21, 2018 12:07 PM
To: Douglas, Mark <douglas.mark@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>
Subject: Pebble EIS wetlands sections

Hi Mark and Molly –
I just took a call from Sheila Newman, Katie McCafferty, and Elizabeth Bella (AECOM). They indicated that the wetlands sections of the PDEIS would be sent to us for review later today. The Corps and AECOM would also like to have a wetlands technical meeting with us sometime during our review period to discuss how they developed the sections and answer any technical questions that we might have based on our preliminary look at the sections. They requested that that the technical meeting be next Thursday or Friday and would be in person at the AECOM office in Anchorage (I could call in, if needed). I told them that we needed to check schedules to see if that would work. Otherwise the technical meeting would be in the following week or two. Should we also include Palmer in this meeting and therefore scheduling?
Patty

Patty McGrath |Mining Advisor
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Seattle, WA 98101
M/S: RAD-202

Office: (206) 553-6113
Cell: (206) 743-7068
mcgrath.patricia@epa.gov

Message

From: McGrath, Patricia [mcgrath.patricia@epa.gov]
Sent: 10/25/2018 10:29:32 PM
To: Vaughan, Molly [Vaughan.Molly@epa.gov]; Wake, Neverley [wake.neverley@epa.gov]; Godsey, Cindi [Godsey.Cindi@epa.gov]; Pepple, Karl [Pepple.Karl@epa.gov]; McAlpine, Jerrold [McAlpine.Jay@epa.gov]; Palomaki, Ashley [Palomaki.Ashley@epa.gov]; Hough, Palmer [Hough.Palmer@epa.gov]; Maley, Timothy [maley.timothy@epa.gov]; Eckley, Chris [Eckley.Chris@epa.gov]; Butler, Barbara [Butler.Barbara@epa.gov]; Douglas, Mark [douglas.mark@epa.gov]; Schofield, Kate [Schofield.Kate@epa.gov]; Thiesing, Mary [Thiesing.Mary@epa.gov]; Muche, Muluken [Muche.Muluken@epa.gov]; Barton, Justine [Barton.Justine@epa.gov]
Subject: FYI. Pebble EIS - Alternatives PowerPoint
Attachments: 20181024 Cooperating Agency Meeting.pdf

Hi All-
During the team meeting today, I mentioned the PowerPoint presentation provided during yesterday's cooperating agency meeting that provided information on the alternatives currently proposed by the Corps/AECOM for evaluation in the draft EIS. Attached is a copy of the presentation.
We still have outstanding questions/comments on some other potential alternatives (dry stack tailings, TSF liner) that we hope to work through with the Corps.
This is just FYI.
Patty

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mcgrath.patricia@epa.gov

Pebble EIS: Cooperating Agency Meeting

October 24, 2018

US Army Corps of Engineers

Pebble Project EIS

Environmental Impact Statement

www.PebbleProjectEIS.com

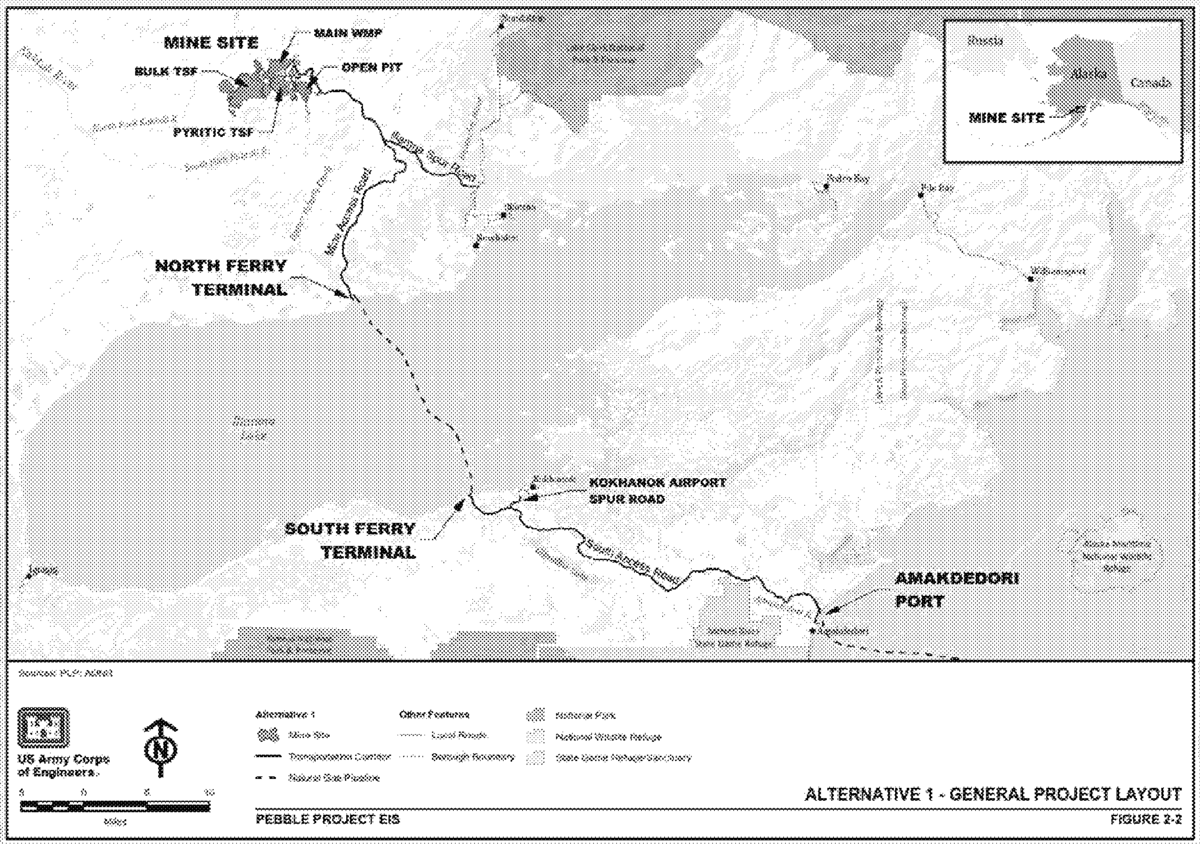
Agenda

- Overview of Alternatives
- Format and Level of Detail for Chapter 2
- Update on Appendix B – Alternatives Development Process
- Review of Select Alternatives
  - Filtered Tailings (Dry Stack)
  - Other Mine Locations
  - Underground Mining

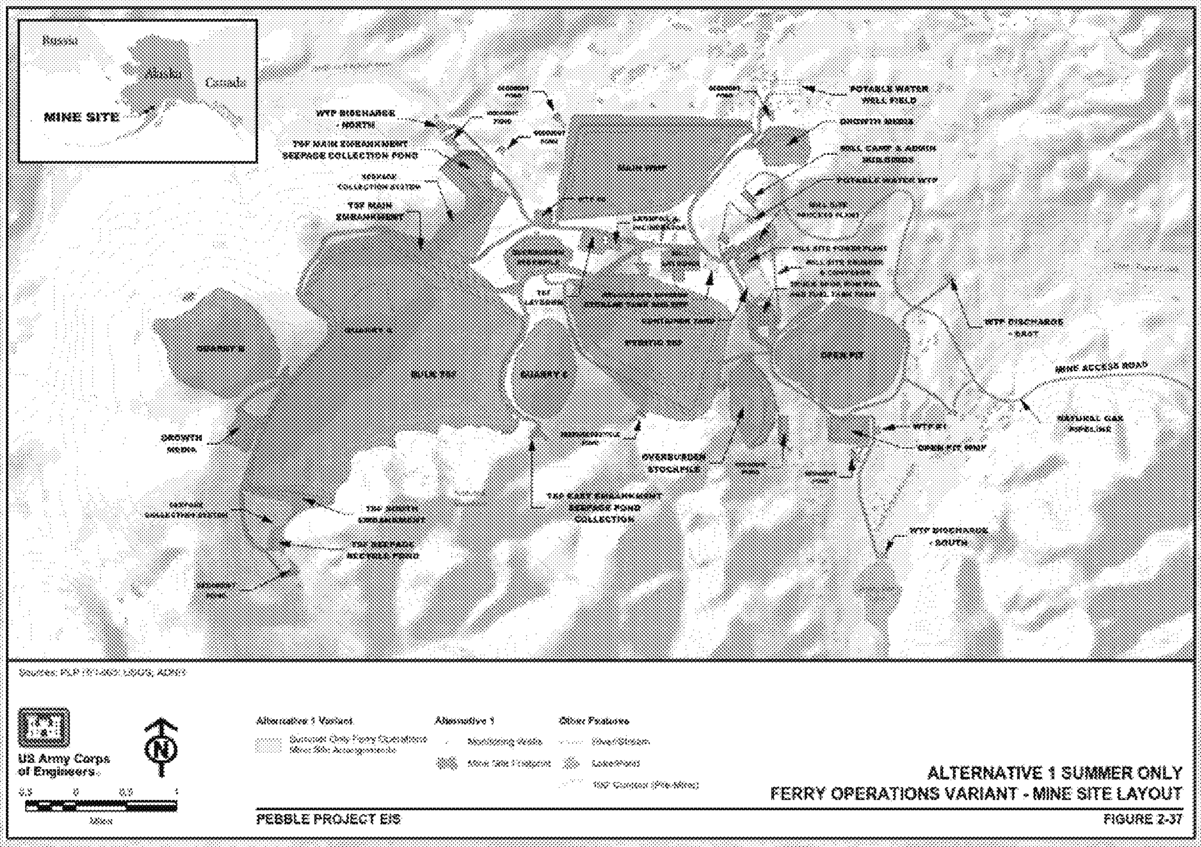
Overview of Alternatives

- Alternatives to be Analyzed in Detail
  - No Action Alternative
  - Action Alternative 1 – Applicant's Proposed Alternative (includes 3 variants)
  - Action Alternative 2 – North Road and Ferry/Downstream Dams (includes 2 variants)
  - Action Alternative 3 – North Road Only (includes 1 variant)

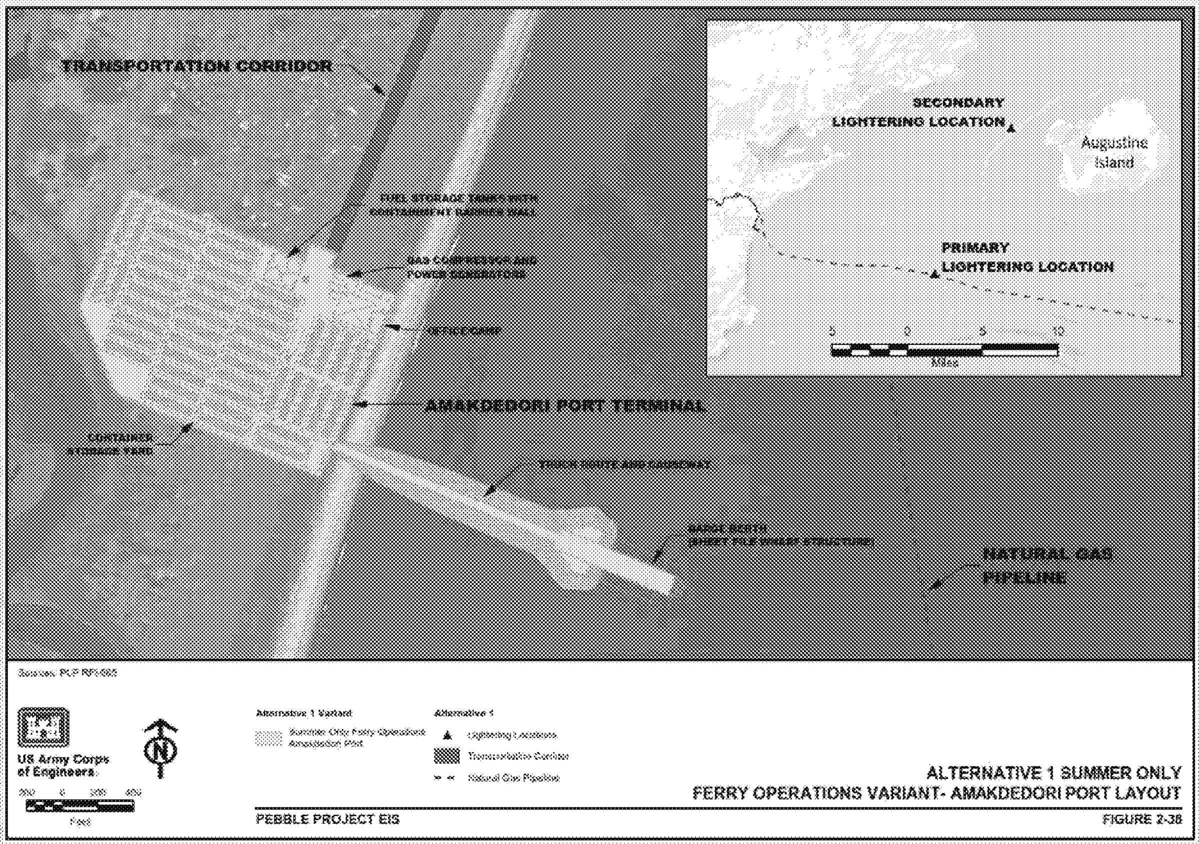
Action Alternative 1



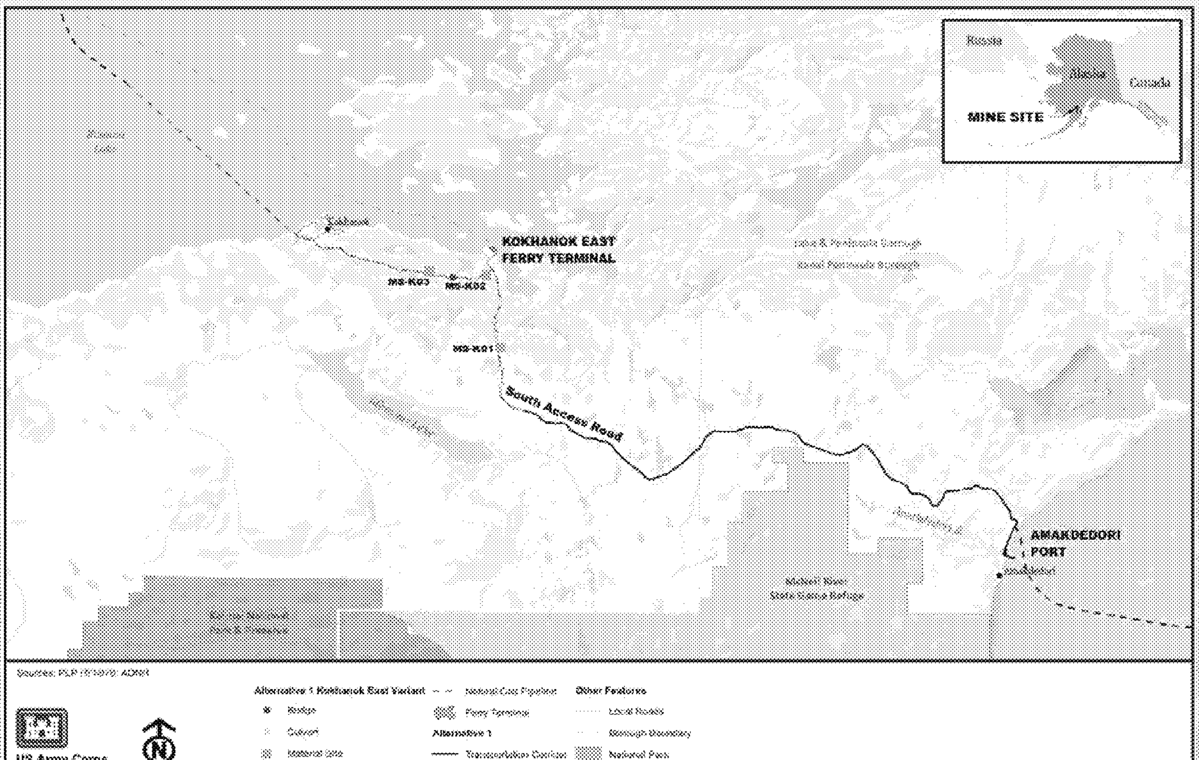
Action Alternative 1 – Summer Only Ferry Operations Variant



Action Alternative 1 – Summer Only Ferry Operations Variant



Action Alternative 1 – Kokhanok East Ferry Terminal Variant

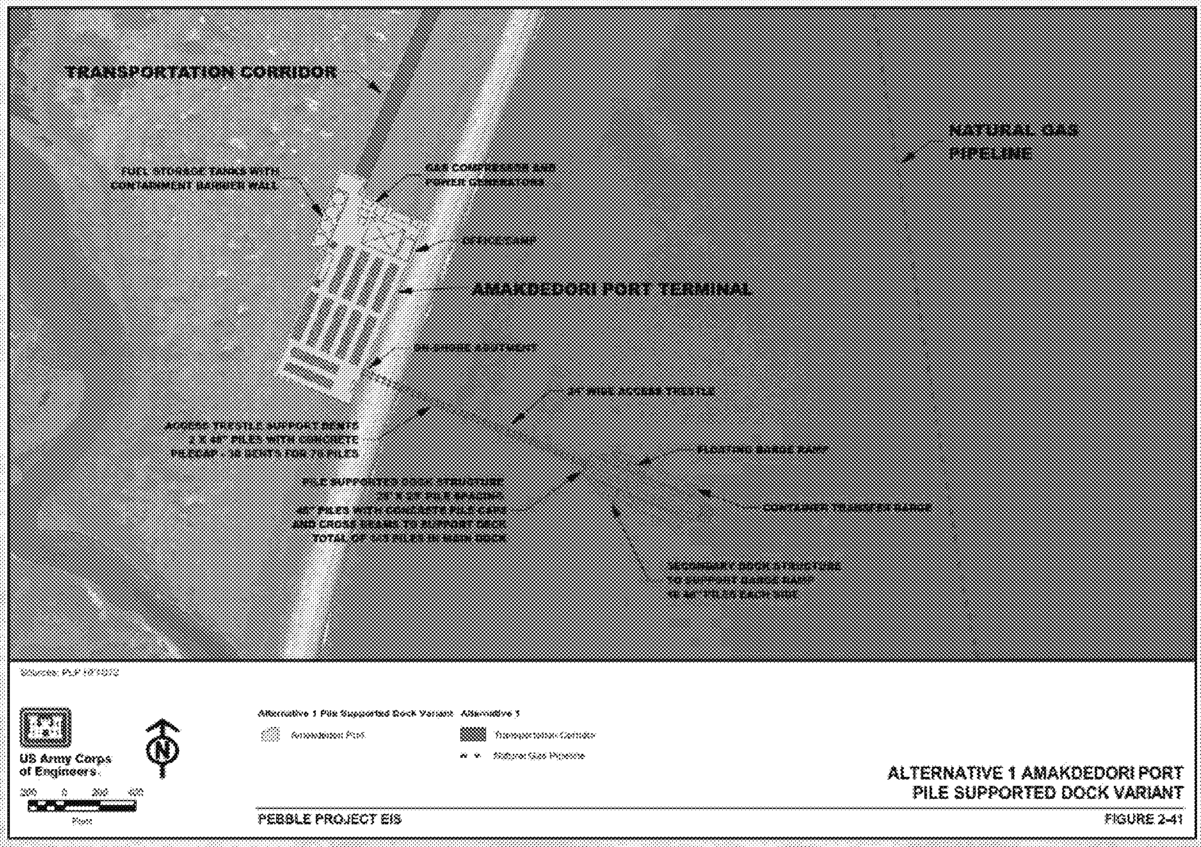


ALTERNATIVE 1 KOKHANOK EAST
FERRY TERMINAL VARIANT

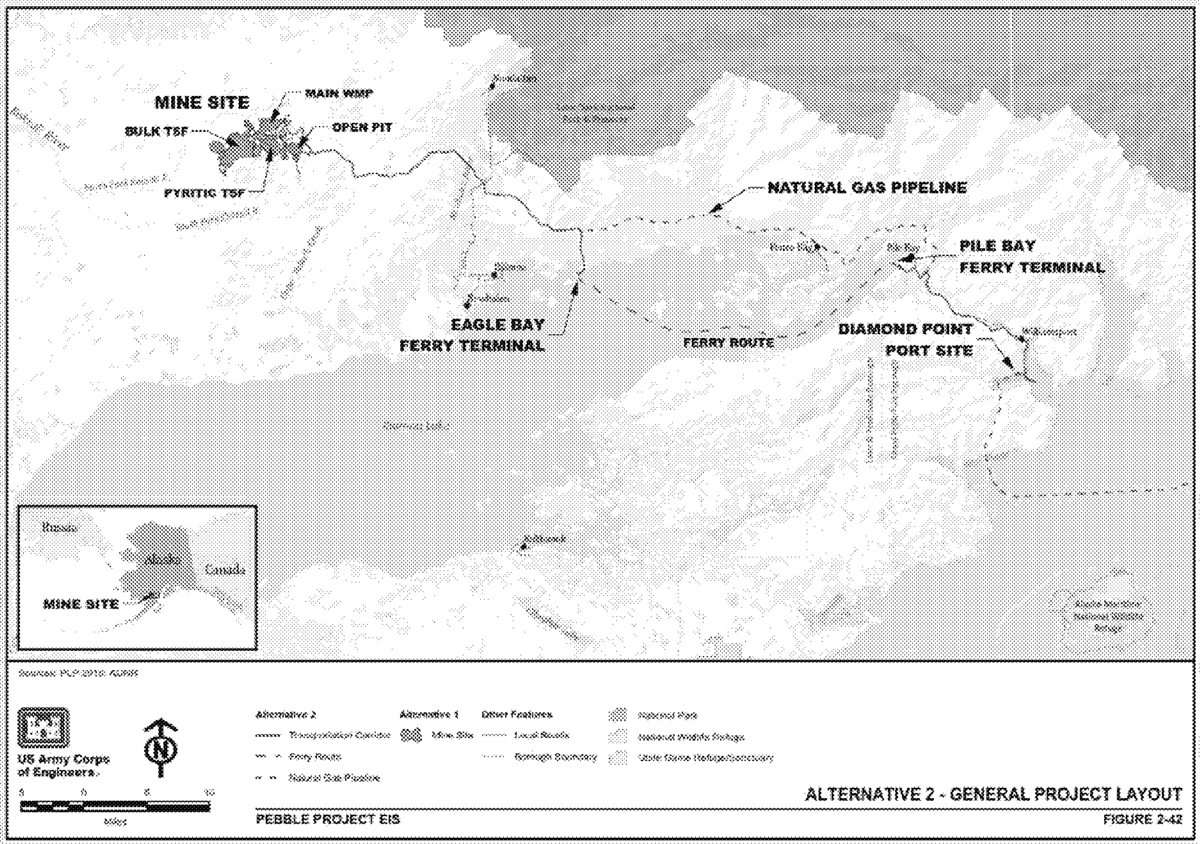
PEBBLE PROJECT EIS

FIGURE 2-39

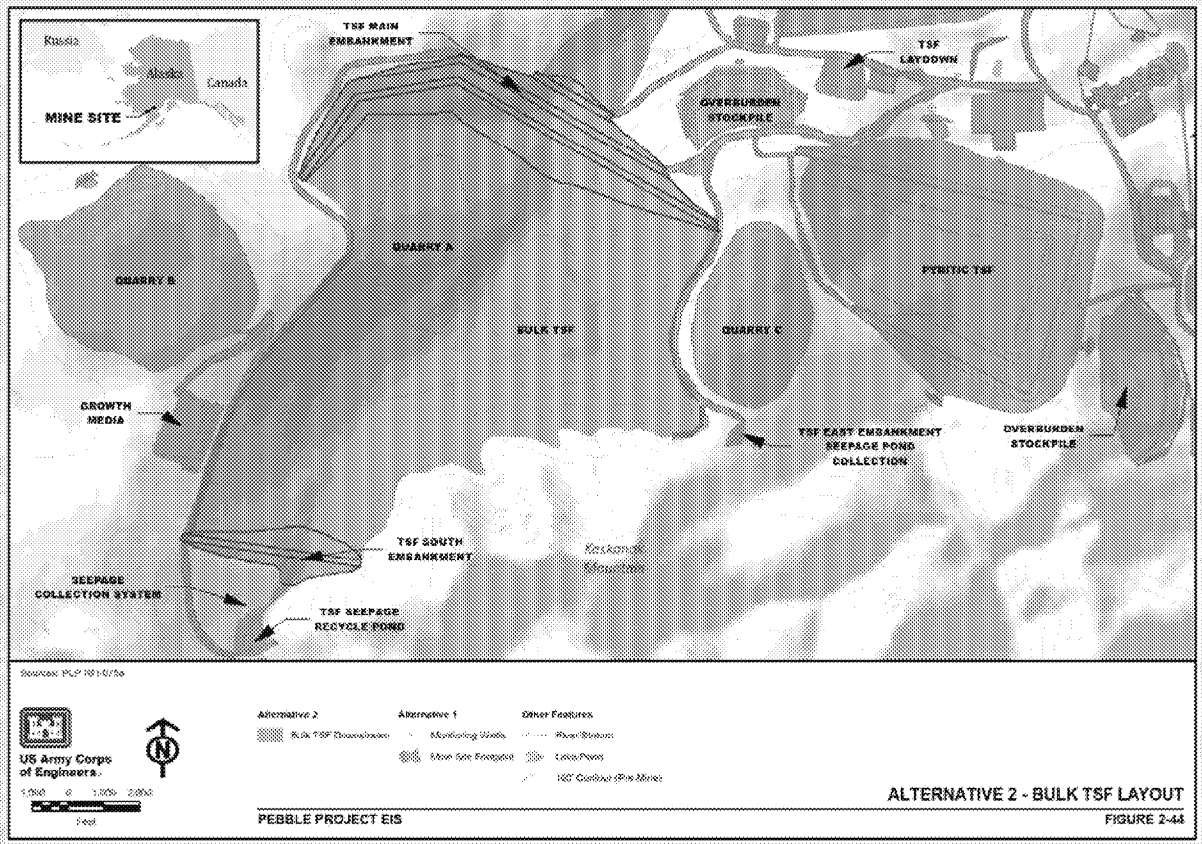
Action Alternative 1 – Pile Supported Dock Variant



Action Alternative 2 – North Road and Ferry/Downstream Dams



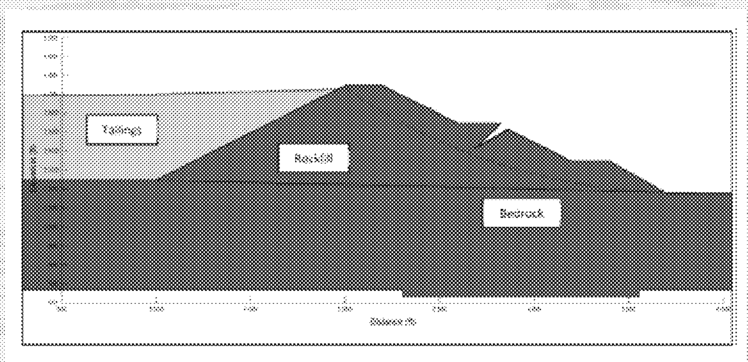
Action Alternative 2 – North Road and Ferry/Downstream Dams



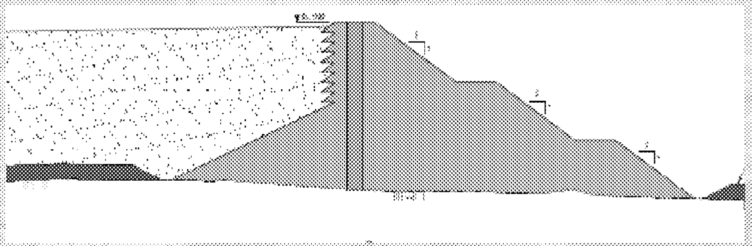
10

Action Alternative 2 – North Road and Ferry/Downstream Dams

Alternative 2 – Bulk TSF Downstream Dam



Alternative 1 – Bulk TSF Centerline Dam



Action Alternative 2 – Summer Only Ferry Operations Variant